

LUNOTRIQUETRAL ARTHRODESIS, A PROCEDURE WITH A HIGH FAILURE RATE

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The authors retrospectively reviewed 29 patients with chronic lunotriquetral ligament tears who were treated with lunotriquetral arthrodesis. Arthrography confirmed the diagnosis in 17 cases, arthroscopy in 18. Associated lesions included 13 TFCC tears and 8 scapholunate ligament tears. The fusion was carried out with staples in 5 cases, a Herbert screw in 17, a Kirschner wire in 6. Bone grafts were used in 24 cases. In 15 cases additional procedures were performed. As for the subjective outcome, 5 patients were fully satisfied, 10 had reservations and 14 were not satisfied ; 17 patients would repeat the procedure. The average Pellenberg wrist score for pain and function was 59/80 (0 no symptoms, 80 maximal pain). Mean grip force was 69% of the contralateral side and lateral pinch force was 79%. Flexion loss averaged 24°, and extension loss 21°. Fusion was achieved in 16 cases ; nonunion persisted in 13. Twelve important complications were noted. In 17 cases the wrist remained painful ; in 19 patients an average of two additional surgical procedures were required. Fusion was obtained in two of seven revision cases ; five remained painful. Three patients went on to complete wrist arthrodesis.

In the light of these results the effectiveness of this procedure has to be reconsidered compared to other alternatives, such as ligamentoplasty and extended arthrodesis (4 corner).

Keywords : wrist ; lunotriquetral ; arthrodesis.

Mots-clés : poignet ; luno-triquétral ; arthrodèse.

INTRODUCTION

Lunotriquetral (LT) tears and their treatment were first described by Reagan *et al.* (11) in 1984.

The results of arthrodesis have been published in four major series (3, 9, 10, 13) and vary widely.

We were dissatisfied with the outcome of our patients and wanted to objectify these results. The purpose of this study was to review our results and find out which technical factors may be related to a poor outcome.

MATERIALS AND METHODS

Patients

Between September 1991 and January 1998, 32 patients underwent lunotriquetral fusion for ulnar wrist pain due to lunotriquetral instability. Three patients were lost to follow-up. Of the 29 patients, 16 were males and 13 were females. Age at the time of operation averaged 32 years (range : 18-49 years). The dominant hand was involved in 16 cases. In 19 cases there was a history of trauma (1 traffic related, 12 work related, 5 sports related). In 10 cases there was a fall on the outstretched hand with ulnar-sided impact. The time between onset of symptoms and presentation averaged 8 months (range 3-24 months). The most universal complaint was ulnar-sided wrist pain in 24 cases ; in 5 cases it was radial wrist pain. In 9 cases the LT ballottement test (11) was positive. Conventional xray tests were completely negative in 21 cases. A static VISI-pattern was noted in 6 cases, and an LT gap was encountered twice.

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Arthrography was performed in 24 cases and demonstrated the lesion in 22 cases. Arthroscopy was performed in 20 cases and visualized the lesion in 18 cases. In 6 cases there was a contradiction. In 19 patients a reoperation had to be done. In this group the average number of reoperations was 2 (range 1 to 5). In 7 cases this was because of a complication ; in 12 because of a persisting painful wrist. The K-wires and staples were removed in 11 patients (screws were never removed).

Surgical technique

A dorsoulnar angled incision was used. The superficial sensory branches of the ulnar nerve were always identified and preserved, (nevertheless complications have been related to this structure). The extensor retinaculum was then divided in a longitudinal fashion at the level of the fifth compartment, the extensor digiti quinti tendon was retracted to the radial side, and the extensor carpi ulnaris to the ulnar side. The dorsal ulnocarpal capsule was then identified. It was incised longitudinally in most cases, although we now prefer to use a ligament-sparing incision parallel with the dorsal radiocarpal ligament, as this leaves the extrinsic stabilizers of the lunotriquetral complex intact. The interosseous ligament was then inspected, and cartilage lesions were noted. The cartilage of the opposing articular surfaces of the lunate and triquetrum was removed. In the reduced position a temporary K-wire was driven from the ulnar anatomical snuffbox through the triquetrum into the lunate. Cancellous bone graft harvested from the dorsal distal radius was used in 16 cases. In 8 cases we used a corticocancellous iliac crest interposition graft (3 to 4 mm wide). The method of fixation also varied : staples were used in 5 cases, 2 K-wires in 6, a single Herbert screw in 17 (fig. 1) and an AO cancellous screw in one. Postoperatively a short arm cast was applied. The K-wires were removed when xrays showed bridging trabeculae. A hand rehabilitation program was started two weeks after cast removal. In 15 patients another procedure was combined in the operation because of associated pathology : in 4 cases a four-bone tendon weave plasty because of a scapholunate tear, in 3 cases ECU tenodesis plasty (Stanley, personal communication) for a scapholunate tear, in 2 cases a scapholunate suture, in 2 cases an ulnar shortening for a TFCC tear, one resection of the TFCC, one shaving of the TFCC, and one extensor tenoplasty for a TFCC tear. Two primary interosseous posterior denervations were also performed.



Fig. 1. — Lunotriquetral fusion with bone graft and Herbert screw.

Evaluation

Evaluation was performed by the junior author (W.V.) who had not taken part in any of the operations. We were able to review 29 patients either in the outpatient clinic or, in 8 cases, by visiting the patient at home ; 3 patients were lost to follow-up.

A subjective assessment was made by the patient. The level of satisfaction was evaluated on a visual analogue score (VAS) : fully satisfied (> 90°) ; satisfied (70-90%) ; not satisfied (< 70%). The patient was also asked whether he would undergo the procedure again in the same situation. A combined pain and active score was recorded (Pellenberg Wrist Score (table I)). In this system the maximum score is 80 points. A score over 70 was considered excellent, 60-70 good, 50-60 fair and under 50 poor. An objective evaluation followed by measurement of the grip force, pinch force and range of motion both of the affected and unaffected limb was performed. Standard xrays were also taken. Finally we recorded the patient's professional activities before injury and at the time of the survey together with duration of work incapacity before and after the operation.

Table I. — Wrist Pain Evaluation Score

1. Pain during activity	
No pain / _____ / Intolerable pain	
(15 points)	(0 points)
2. Pain at rest	
No pain / _____ / Intolerable pain	
(15 points)	(0 points)
3. Nocturnal pain	
I have no pain at night	10 points
moderate pain at night	5 points
severe pain (disturbed sleep due to the wrist pain)	0 points
4. Level of activity-work/recreational activities	
I do all kinds of work/recreational activities	20 points
I do most kinds of work/recreational activities but have to avoid a heavy load on my wrist	12 points
I do not do any kind of work/recreational activities that puts a load on my wrist	5 points
I cannot do anything with my hand (wrist)	0 points
5. Activities of daily living	
I can do all kinds of housework	20 points
I can do most kinds of housework except some of the heavy cleaning, laundry, etc.	12 points
I cannot do any of the housework because of the wrist	5 points
I cannot do anything with my hand because of the wrist (need help with personal hygiene)	0 points
Questionnaire/score for subjective assessment of pain and level of activity.	

RESULTS

Five patients (17%) were subjectively very satisfied, 10 (34%) were satisfied and 14 (48%) were not satisfied. Seventeen stated that they would repeat the procedure under the same conditions, 12 (41%) said they would not. The average Pellenberg wrist score was 59/80 (= fair). In the nonreoperated group the average score was 68/80 (good) and in the reoperated group 54/80 (fair).

The grip force postoperatively was 30 kg (70.5% of the opposite side). The key pinch force was 7 kg (79.5% of the opposite side). The range of motion was reduced by 36% in flexion (41°) and 33% in extension (41.5°).

The average grip force in the nonreoperated group was 28 kg (81% of the contralateral side) which means a loss of 7 kg compared with the non-operated side; average key pinch force in this group was 7 kg (79% of the opposite side), i.e. a

loss of 2 kg compared with the nonoperated side. In the reoperated group the average grip was 30 kg (65%), a loss of 7 kg and the average key pinch force was 8 kg (80%), a loss of 2 kg. There was a loss of 20° in flexion, 11° in extension, 11° in ulnar deviation, 6° in radial deviation, 12° in prosupination in the nonreoperated group. In the reoperated group we measured a loss of 26° in flexion, 26° in extension, 19° in ulnar deviation, 10° in radial deviation, 51° in prosupination (The outcome is summarized in table II).

In 12 patients (29%) there were complications (nonunion or painful fusion not included): 4 patients developed reflex sympathetic dystrophy, which was treated with calcitonin injections. Ulnar nerve neuromas were seen in 4 patients, who were treated with resection of the neuroma and in one case with revision neurectomy of the superficial ulnar nerve. This patient eventually underwent complete wrist fusion because of persistent pain.

Table II. — Results according to groups

	N	Pain		Complications	Reoperations	Satisfaction			Repeat procedure		Wrist score	Grip force (kg)	Pinch (kg)	Flexion	Extension
		Y	N			Very	Satisf.	not	Y	N					
Total	29	17	12	12	19	5	10	14	17	12	59 (fair)	30	7	41°	41.5°
Fusion	16	6	10	7	9	4	6	6	9	7	62 (good)	27	7	41°	41°
Nonunion	13	11	2	5	10	1	4	8	8	5	55 (fair)	33	7	41°	43°
No reoperation	10	1	9	1	0	4	4	2	6	4	69 (good)	28	7	48°	50°
Reoperation	19	16	3	11	19	1	6	12	11	8	54 (fair)	30	8	38°	38°

Pisotriquetral impingement was seen in 3 patients and was treated twice by excision of the pisiform. One patient developed arthrofibrosis of the wrist and required mobilization under general anesthesia.

Radiologically 16 patients (= 55%) went on to solid union (fig. 1) and 13 patients (= 44%) developed nonunion (fig. 2). Union, when achieved, was apparent after an average of 4.5 months. In 17 cases (= 60%) the wrist remained painful regardless of whether fusion was obtained or not.

In trying to discover factors which influence radiologic outcome we noted the fusion rate in the group without bone graft was 40% (2/5). In the group where cancellous bone graft from the distal radius was used, fusion was 62% (10/16). In the group with corticocancellous iliac grafts, fusion was 50% (4/8) ($p = 0.45$ chi-square). We noted different fusion rates according to the fixation techniques used: 64% (11/17) in the Herbert group, 50% in the K-wire group (3/6), 20% in the staple group (1/5) ($p > 0.05$ chi-square). The high rate of nonunion (16 patients or 55%) was not related to sex, age or surgeon ($p > 0.05$ chi-square).

In the nonunion group there were 11 patients with pain out of 13 (85%) of whom 10 had a reoperation; in the fusion group there were 6 in pain out of 16 (37%) of whom 9 had a reoperation ($p = 0.011$, chi-square; $p = 0.03$ Yates chi-square, $p = 0.022$ Fisher exact). Seven patients from the nonunion group underwent a revision lunotriquetral fusion of whom two went on to solid fusion



Fig. 2. — Pseudarthrosis of lunotriquetral fusion

(28%), both without pain. Five revision cases had nonunion (72%), four of whom remained in pain and one of whom resolved. Four-corner fusion was carried out in two cases because of painful nonunion: both wrists remained painful and a full wrist arthrodesis was performed in both. In the fusion group denervation by division of the posterior interosseous branch of the radial nerve was performed in two patients. In one case it led to a satisfactory outcome; in one case it led to an unsatisfactory outcome and further salvage procedures had to be carried out (four-corner fusion and full wrist fusion). In three cases a full wrist fusion eventually had to be carried out (one in the nonunion group, two in the fusion group), leading

in one case to a satisfactory outcome in a highly active person with a demanding job ; in two cases it led to an unsatisfactory outcome, both of these patients receiving full permanent workers' compensation. Five patients had to change their jobs (17%). There was a nonsignificant difference regarding work resumption between the fusion group (12%) (2/16) and the nonunion group (23%) (3/13). The average absence from work before intervention was 10 weeks ; after intervention it was 45 weeks in the fusion group and 156 weeks in the nonunion group.

DISCUSSION

The treatment of lunotriquetral tears has been addressed in the literature since the early eighties, with Taleisnik *et al.* reporting the first case in 1982 (6, 16). The idea to perform an arthrodesis also dates back to this time ; it was based upon the observation that congenital carpal coalitions such as lunotriquetral coalition were well tolerated in most cases (4, 15).

Reagan *et al.* (11) published a series of arthrodeses in 1984. In their review of seven patients no true fusion rate was mentioned with two good, one fair and four poor results. Meanwhile five other larger series of lunotriquetral fusions have been published. The first one was by Pin *et al.* (10) in 1989 showing complete fusion in 9 patients out of 11, with 4 good, 4 fair and 3 poor results. In 1993 Kirchenbaum *et al.* (3) had 12 fusions out of 14, and only 2 patients were pain free. Also in 1993 McAuliffe *et al.* (8) achieved 7 successful fusions out of 14. In 1995 Sennwald *et al.* (13) had a fusion rate of 10/23 or 43% and entitled their paper "lunotriquetral arthrodesis, a controversial procedure". Maitin *et al.* (7) had 14 unions out of 18. Nelson's article (9) also mentioned a series of 42 by Keck and Hastings with 28 fusions and complications in 20, but no reference to the original article is given. Nelson also mentions Smith and Rayhack with 5 questionable fusions out of 18. The fusion rate in the literature ranges between 100% and 43%.

In our series the fusion rate was only 55% (16 out of 29 patients). Different authors have stated

that the use of compression screws such as Herbert screws led to a higher fusion rate (9, 10). Our data confirm this statement, as the fusion rate in our series was highest in the Herbert group (64%), compared to 50% in the K-wire-group and 20% in those fixed with staples. We also found a different fusion rate between the group without bone graft (40%) and the groups with bone graft (cancellous distal radial grafts 62% and iliac corticocancellous grafts 50%). The series are too small to detect statistical significance (chi square).

The complication rate varies in the literature between 22% and 46% (9). In our series, it was 29%. Reflex sympathetic dystrophy, ulnar nerve neuromas and pisotriquetral impingement were the most frequent complications in our study as well as in others (13).

The function loss after lunotriquetral fusion as measured in our study was very similar to that in other series (9). The grip strength loss and pinch loss was 19%, which is nearly identical to Nelson's series (9) and Sennwald's series (13). The flexion loss was 20° or 30%, extension loss was 11° or 18%, very similar for instance to Sennwald's series : flexion -15%, extension -12%.

The subjective outcome in our series did correlate with the objective outcome. Satisfaction (as asked directly to the patient) was not correlated with fusion.

The high number of reoperations — 19 out of 29 patients or 65%, were reoperated with a total of 46 reoperations — was not mentioned in other series. The 7 revision cases showed a low fusion rate of 2 of 7.

We found the procedure had a high social impact with 17% having to change their jobs and an extended loss of working weeks after the procedure even in the fusion group (45 weeks on average in the fusion group).

We conclude from these data that lunotriquetral arthrodesis in the treatment of ulnar wrist pain in a patient with a lunotriquetral tear, which is most often associated with other intra-articular lesions, leads to a high nonunion rate regardless of the technique, and to a high complication rate, a reasonable functional loss and a subjective outcome which does not always correlate with the objective result.

It is important to analyze three possibly important factors to evaluate these data : 1) A lunotriquetral tear is seldom an entity on its own ; it is most often part of a more general wrist problem with a high rate of associated pathology such as TFCC and scapholunate tears. 2) Our diagnostic tools only provide information on the interosseous ligaments and none about the condition of the volar and dorsal capsular ligaments. Anatomically the relation between lunate and triquetrum is not only dictated by the interosseous ligaments alone. Only the intrinsic interosseous ligaments can be visualized on arthrography and arthroscopy. Only in true cases with a static VISI deformity can one presume that these are failing completely as well. The Mayo Clinic hand group has published several biomechanical studies (1, 2, 12) demonstrating the importance of the extrinsic ligaments in stabilizing the lunate and triquetrum. On the volar side the ulnocarpal ligaments and on the dorsal side the radiotriquetral and the scaphotriquetral ligament play a very important role. We are convinced that damage to these extrinsic ligaments is an important factor in the pathogenesis of ulnar side instability. 3) There is a biomechanical reason to explain the general poor outcome. The Mayo Clinic hand group (1, 2, 12) and others in numerous publications (5, 14, 17, 18) have shown the importance of the gliding movement of the triquetrum on the hamate for the flexion-extension of the proximal row during ulnar-radial deviation of the wrist. The fact that these complex movements can no longer take place after lunotriquetral fusion is one of the possible explanations for the high nonunion rate, the existence of painful fusions and possible pisotriquetral maltracking.

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SAMENVATTING

W. VANDESANDE, L. DE SMET, H. VAN RANSBEECK. Lunotriquetraal arthrodesis : een frekwent falende ingreep.

In een retrospectieve studie werden 29 patiënten, met chronisch lunotriquetrale instabiliteit behandeld met arthrodesis, nagekeken. Er waren 13 vrouwen, 16 mannen met een gemiddelde leeftijd van 32 jaar en een

gemiddelde follow-up van 6 jaar (2 tot 8 jaar). In 19 gevallen was er een duidelijk traumatische voorgeschiedenis, meestal een val op de uitgestrekte hand met ulnaire impact. De klinische tests waren onbetrouwbaar voor de diagnose. Overzicht radiografieën waren normaal in 21 polsen. Een VISI configuratie werd 6 maal gezien en een verbreding van de lunotriquetrale gap bij 2 patiënten.

Een arthrografie toonde een lek in 17 gevallen en de arthroscopie bevestigde de diagnose in 18 gevallen. Geassocieerde letsels waren TFCC scheuren (13 maal) en scapholunaire ligamentscheuren (8 maal). De fusie werd uitgevoerd met krammen bij 5, een Herbertschroef bij 17 en een Kirschnerpen bij 6 gevallen. Er werden 24 maal botenten aangebracht, 16 maal uit de distale radius, 8 maal uit de bekkenkam. In 15 gevallen werden er geassocieerde procedures toegevoegd.

Voor wat betreft de subjectieve beoordeling waren er 17 patiënten die de procedure zouden herhalen, 5 waren volledig tevreden, 10 hadden bemerkingen en 14 waren niet tevreden. De gemiddelde Pellenberg pols-score voor pijn en functie was 59/80 (0 geen symptomen, 80 maximale pijn). Een fusie werd bekomen bij 16 polsen. Een persistente pseudarthrose bij 13 gevallen. Wij noteren 12 belangrijke complicaties. Bij 17 patiënten bleef de pols pijnlijk en bij 19 was additionele chirurgie noodzakelijk met een gemiddelde van 2 procedures. In 7 revisiegevallen werd een fusie bekomen bij 2 en 5 bleven pijnlijk. Drie patiënten ondergingen een volledige radiocarpometacarpale arthrodese. De gemiddelde grijpkracht was 69% van de contra-laterale zijde, de gemiddeld key-pinch was 79%. Het flexieverlies bedroeg gemiddeld 24° en het extensieverlies was 21° ten opzichte van de contralaterale zijde. In het licht van deze weinig bemoedigende resultaten menen wij dat deze procedure moet vergeleken worden met andere alternatieven.

RÉSUMÉ

*W. VANDESANDE, L. DE SMET, H. VAN RANSBEECK.
L'arthrodèse luno-triquétrale, une opération à haut risque d'échec.*

Les auteurs ont revu de façon rétrospective 29 patients traités par arthrodèse luno-triquétrale pour des lésions ligamentaires anciennes. Le diagnostic a été confirmé par arthrographie dans 17 cas, par arthroscopie dans 18. Parmi les lésions associées, on relevait 13 lésions du fibrocartilage triangulaire et 8 déchirures du ligament scapho-lunaire. L'arthrodèse a été réalisée avec des agrafes dans 5 cas, avec une vis de Herbert dans 17 cas, avec une broche de Kirschner dans 6 cas. Des greffes osseuses ont été utilisées 24 fois. D'autres gestes chirurgicaux ont été associés dans 15 cas. Cinq patients se sont déclarés totalement satisfaits, 10 ont émis des réserves et 14 étaient mécontents ; 17 patients se disaient prêts à subir à nouveau la même opération ; la valeur moyenne du score de Pellenberg pour le poignet était de 59/80 pour la douleur et la fonction (0 = asymptomatique, 80 = maximum de douleur). La force de préhension moyenne était à 69 % de la valeur contro-latérale et la force de la pince latérale était à 79%. On notait une perte de flexion de 24° en moyenne, et d'extension de 21°. La consolidation a été obtenue dans 16 cas ; il y a eu 13 pseudarthroses. Douze complications importantes ont été notées. Le poignet est resté douloureux dans 17 cas ; 19 patients ont subi une moyenne de 2 réinterventions. La fusion a été obtenue dans deux des sept cas repris ; cinq restaient douloureux. Trois patients ont terminé avec une arthrodèse complète du poignet.

Au vu de ces résultats, on doit remettre en question l'intérêt de cette opération, en regard d'autres techniques de ligamentoplastie ou d'arthrodèse étendue.