ARTHROSCOPIC TRIANGULAR FIBROCARTILAGE COMPLEX DEBRIDEMENT USING RADIOFREQUENCY PROBES

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The initial results of using radiofrequency probes for debridement of a torn triangular fibrocartilage complex were studied in 20 patients with a mean age of 44 (range 27–56) years presenting with ulnar-sided wrist pain. On arthroscopic examination, 18 central and two radial triangular fibrocartilage complex tears were identified and debrided to a stable rim using radiofrequency probes. The mean follow-up was 22 (range 9–35) months. Seventeen patients experienced substantial pain relief. In three, the pain was unchanged. The mean flexion extension arc was 132°, pronosupination arc 155° and mean grip strength was 83% of that of the unaffected side. Using the modified Mayo wrist score, there were ten excellent, seven good, and three fair results. No perioperative complications occurred. Radiofrequency probes were found to be safe and effective for use in triangular fibrocartilage complex debridement. These results compare favourably with other standard methods of treatment of this problem.

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INTRODUCTION

Triangular fibrocartilage complex (TFCC) tears have long been recognized as a common cause of ulnar-sided wrist pain. The most widely accepted classification of TFCC tears was outlined by Palmer and is used to guide treatment selection (Palmer, 1989). In that classification, TFCC lesions are divided into traumatic (class 1) or degenerative (class 2). Traumatic lesions are treated by debridement of central and radial tears and by repair of ulnar and radial tears. Degenerative symptomatic tears are considered to be the result of ulnar impaction syndrome and the optimal treatment is considered to be debridement of the lesion supplemented by a procedure to recess the ulnar head (a wafer procedure or extraarticular ulnar shortening). Debridement of TFCC tears has been almost invariably performed arthroscopically in recent reports using synovial resectors, punches and arthroscopic blades, with good results reported (Bednar, 1999; Cober and Trumble, 2001; Fulcher and Poehling, 1998; Husby and Haugstvedt, 2001; Minami et al., 1996; Osterman 1990; Westkaemper et al., 1998).

The use of electrosurgical (radiofrequency) devices in arthroscopic surgery has gained increasing popularity in recent years as a tool for resection, ablation and coagulation. Efforts have also been made to extend their use to soft tissue thermal shrinkage and chondroplasty (Medvecky et al., 2001; Owens et al., 2003; Polousky et al., 2000; Sherk et al., 2002; Wallace et al., 2000). Although radiofrequency probes are versatile and functional, questions remain concerning their efficacy. The development of small joint radiofrequency probes has permitted their use in the wrist joint (DeWal et al., 2002) but results have not yet been reported. TFCC debridement is one of the first fields of application for this technology. Radiofrequency probes are small and easily controllable permitting simple access to the wrist joint. They are precise, as heating of the treated tissue does not exceed a 1 mm rim (Wallace et al., 2000). Moreover, they provide coagulation and a thermal shrinkage effect at the periphery of the tissue treated, as collagen molecules uncoil and shorten under the heating effect of the RF probe (Medvecky et al., 2001). This shrinkage effect may be beneficial in creating a more stable rim after TFCC debridement.

The purpose of this study is to present our experience with the use of radiofrequency probes in TFCC debridement.

PATIENTS AND METHODS

From 2001 to 2003, 31 patients were treated with radiofrequency TFCC debridement. Seven patients in whom debridement was supplemented by another procedure concurrently (a wafer procedure in two cases and ulna shortening osteotomy in five cases) were excluded from this study. Three more patients with concomitant scapholunate ligament tears and small central TFCC tears who were complaining of radial-sided pain were excluded, as the scapholunate tear was considered the primary source of their pain. One patient was lost to follow-up.

Twenty patients, thirteen female and seven male, with a mean age of 44 (range 27–56) years were treated by arthroscopic TFCC debridement alone using a radiofrequency probe. A history of trauma could be elicited in

16 patients. Eighteen patients complained of ulnar-sided wrist pain. Two patients presented with radial-sided pain but with no radial pathology. Because they had no radial-sided pathology they were not excluded from the study. The mean duration of symptoms prior to surgery was six (range 3–18) months. The TFCC compression test (ulnar deviation and axial loading of the wrist) was positive in 11 and clicking could be reproduced with pronosupination in 14 patients. Pre-operative ranges of motion values were available for all patients and grip strength values were available for ten patients (Table 1).

The pre-operative radiographs of the patients were reviewed. Pronated grip view radiographs were available for all patients. Ulnar variance was assessed from the pronated grip view using the method of perpendiculars (Tomaino, 2000). Measurements were made using computer-aided design tools on digitized images (Medstrat, Medstrat Inc., Downers Grove, IL). Ulnar variance was found to be within 2 mm of neutral in 17 and negative in three patients. MRI was performed in 16 patients and revealed TFCC pathology in 13 and other intraarticular pathology in three. A wrist arthrogram was performed in five patients and revealed a TFCC tear in all.

Wrist arthroscopy was performed using standard technique with the arm supported on a tower distraction device and 10 to 15 lb of distraction applied to the wrist. The 3-4 portal was used for viewing, the 6U portal for outflow and the 4-5 and 6R portals for instrumentation. The wrist was examined from radial to ulnar and scapholunate and lunotriquetral ligament integrity was examined by inserting a probe to the joint. The scaphoid, lunate and triquetral articular surfaces were probed in search of chondral lesions. The TFCC should also be probed as small TFCC tears may not be readily visible. When a central (Fig 1) or a radial (Fig 2) tear was discovered, a 2.3 mm bipolar radiofrequency probe (Vapr, Mitek, Westwood, MA) was introduced through the 6R portal and debridement was initiated. Debridement progressed in a circular fashion (Fig 3). The RF probe was applied intermittently for a few seconds at a time and adequate outflow was ensured throughout the procedure to avoid overheating of the joint.

The TFCC should be debrided to a stable rim. In cases of a central tear, it is important to remove all residual tissues from their attachment to the radius in order to avoid recurrent clicking and pain. By completion of the debridement, the ulnar head articular cartilage should be visible through the defect (Fig 4). If ulnocarpal inpaction syndrome exists, an area of the ulnar head denuded of cartilage may be seen. In cases of lunotriquetral tear and when lunate or triquetral chondral lesions were found in association with a positive ulnar variance in the pronated grip view, an

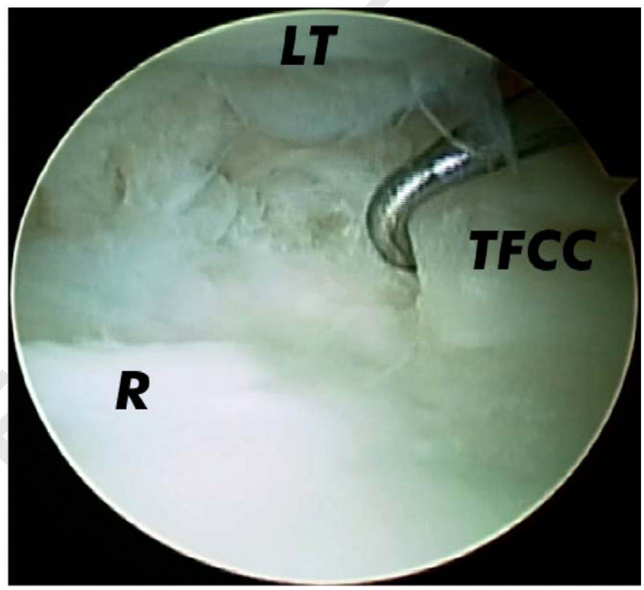

Fig 1 A central TFCC tear with a probe inserted to outline it. (R) radius; (LT) lunotriquentral interosseous ligament.

Table 1—Summary of results

		Pre-operative mean (range)	*Follow-up (n = 20) mean (range)*
Ranges of motion (deg)	Flexion	58 (20–65)	65 (50–90)
	Extension	60 (30–70)	67.5 (55–90)
	Radial deviation	22 (10–30)	18 (15–25)
	Ulnar deviation	21 (0–30)	30 (25–35)
	Supination	64 (30–90)	74 (60–90)
	Pronation	68 (50–90)	79 (70–90)
Grip strength (expressed as a % of the contralateral hand)		64 (40–85)*	83 (65–115)
Mean pain (visual analogue scale)	Rest	6.0†	2.7
	Everyday activities	7.8†	3.8
	Heavy manual work	8.5†	5.2

*Pre-operative grip strength measurements available on 10 patients.
†Pre-operative VAS rating obtained retrospectively. Pre-operative ROM and postoperative ROM, grip strength and VAS measurements available for all 20 patients.

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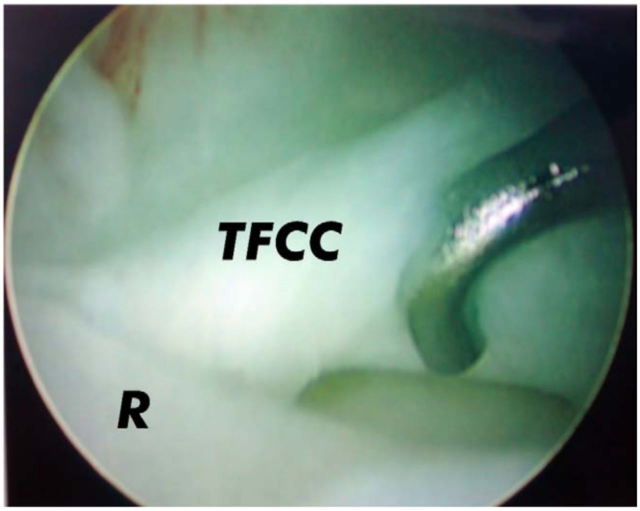

Fig 2 A radial TFCC tear: (R) radius.

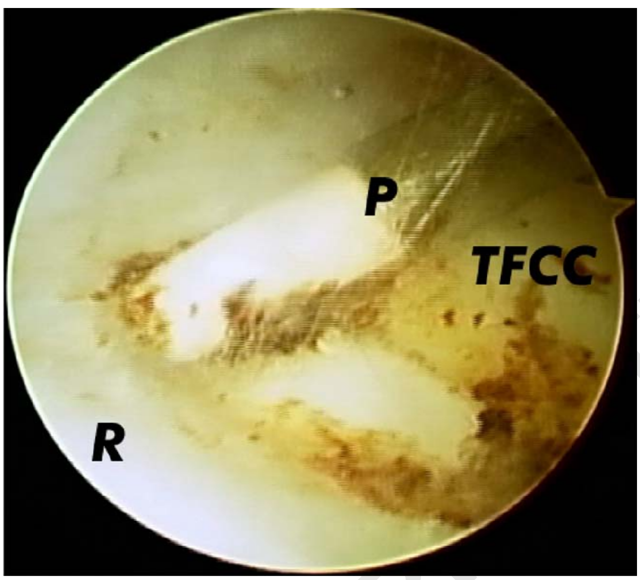

Fig 3 Arthroscopic debridement of a central TFCC tear using a radiofrequency probe (P): (R) radius.

ulnar recession procedure (wafer or extraarticular ulnar shortening osteotomy) was performed after the completion of the debridement of the TFCC. These seven patients with ulnar recession procedures are not included in this study. At the end of the procedure the wrist was immobilized in a short arm splint.

Postoperatively a splint was used for 2 weeks for comfort. Range of motion exercises were initiated in the second postoperative week. Strengthening exercises were introduced after the fourth week. The patients were allowed to return to light duty work at the end of sixth week, as tolerated.

At follow-up examination, the patients were asked to record their pain levels on a visual analogue 10-point

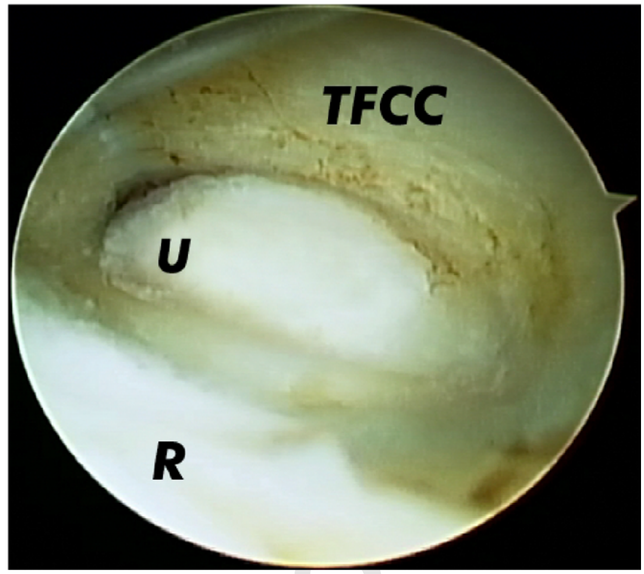

Fig 4 View of a central TFCC tear after debridement with a radiofrequency probe to a stable rim. Note that there is no redundant tissue attaching to the radius (R) and that part of the ulnar head (U) is visible through the debrided tear.

scale (VAS) at rest, with everyday activities and carrying out heavy manual work. In this scale, 0 indicated "no symptoms" and 10 "pain as bad as it could possibly be". The patients were also asked, retrospectively, to record their pre-operative pain levels. The range of motion of the wrist was measured. Grip strength was measured, both in the affected and the contralateral extremity, with a Jamar hydraulic dynamometer (Sammons Preston, Bolingbrook, IL). The Modified Mayo wrist score (Cooney et al., 1987) was used to assess the functional results.

RESULTS

On arthroscopic examination, 14 Palmer 1A (traumatic, central) and two Palmer 1D (traumatic, radial) lesions were found. Four patients with a central perforation of the TFCC and no history of specific trauma to the wrist were also identified. All four of these patients were symptomatic without any other signs of ulnocarpal impaction. Ulnar variance was under +1 mm in all of them and no chondral lesions or lunotriquetral tears were found during arthroscopy. Concomitant synovitis was discovered in 15 patients, chondral lesions of the lunate or triquetrum in three and partial scapholunate or lunotriquetral tears were debrided in three. Patients with concomitant scapholunate tears and radial-sided wrist pain were excluded from this study. All tears were debrided using a radiofrequency probe.

The mean follow-up of the patients was 22 (range 9–35) months (Table 1). Seventeen patients experienced

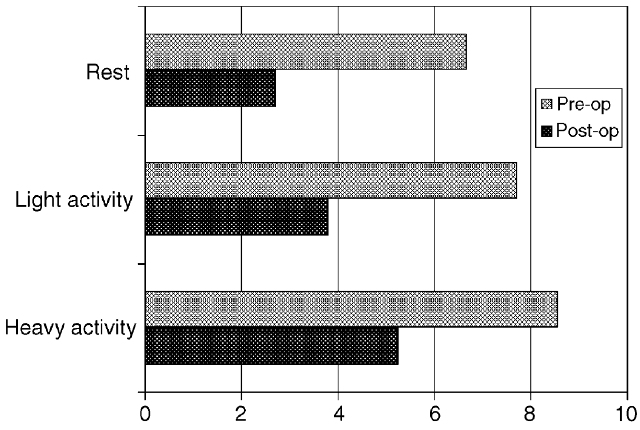

Fig 5 Diagram demonstrating the pre-operative and postoperative mean visual analogue pain values at rest and during light and heavy activity. In this scale, 0 indicates "no symptoms" and 10 "pain as bad as it could possibly be".

substantial pain relief, whereas the pain remained unchanged in three. The mean VAS pain levels at rest and during activities are compared in Fig. 5. The mean flexion extension arc was 132°, the mean pronosupination arc was 155° and mean grip strength was 83% of that of the contralateral side. Using the modified Mayo wrist score, there were ten excellent, seven good and three fair results. All patients with a fair result were involved in worker's compensation cases.

No perioperative complications occurred. One of the patients with a fair result at follow up was noted to have a +2 mm ulnar variance in the pronated grip view. He, subsequently, underwent an MRI which showed signal changes in the lunate and was treated by ulnar shortening osteotomy. During re-arthroscopy, the TFCC debridement was deemed adequate and a chondral lesion of the lunate was found which had not been noted during the first arthroscopy. The other two patients with a fair result declined further treatment. Of the 16 patients who were employed at the time of the procedure, 11 returned to the same or similar work duties and five to lighter work.

DISCUSSION

Results from arthroscopic debridement of TFCC tears have been uniformly good in the literature. Minami et al. (1996) reported pain relief in 81% of 16 patients. Poor results were observed in patients with positive ulnar variance, concomitant lunotriquetral ligament tears and degenerative TFCC tears in that study. Husby and Haugstvedt (2001) reported 77% good and excellent results using the Modified Mayo Wrist Score in a study of 35 patients with central and radial TFCC tears. Blackwell et al. (2001) used a laser probe to debride 35 central TFCC tears with 68% good to excellent results using the modified Green-O'Brien score. Worker's compensation patients had less favourable outcomes in that study. Osterman (1990) reported a 73% rate of complete pain relief in a study of 52 arthroscopically treated TFCC tears, but, in 25% of the wrists in that study, debridement was supplemented by a arthroscopic wafer procedure. The results of those patients with the additional procedure were not reported separately. The senior author (DGS) has published his experience of debridement of TFCC tears between 1990 and 1994 using mechanized resectors (Westkaemper et al., 1998). Twenty-eight patients were treated, with 13 excellent, eight good, two fair and five poor results. Three of the patients with poor results from that study subsequently underwent an ulnar shortening osteotomy. Overall, the rate of good and excellent results was 75%. The results in this study compare favourably. The rate of good and excellent results using the Modified Mayo Wrist Score was found to be 85%. Although radial tears were debrided in this and another report (Husby and Haugstvedt, 2001), the number of patients remains too small to draw safe conclusions concerning this modality of treating radial tears. Repair is another option of treatment of these lesions (Cooney et al., 1994; Jantea et al., 1995; Sagerman and Short, 1996; Shih et al., 2002).

The Palmer classification (Palmer, 1989) continues to be a useful tool in guiding treatment in TFCC lesions. However, occasionally one comes across patients who do not fit exactly into this classification. Some patients present with a TFCC perforation without any signs of ulnocarpal impaction and have no history of specific trauma to the wrist, as was the case with four patients in this study. On the other hand, some patients with evident ulnocarpal impaction relate the initiation of their symptoms to a traumatic event. The distinction into traumatic or degenerative tears cannot be made on the basis of history alone. When faced with a TFCC lesion, the surgeon should decide if ulnar impaction syndrome co-exists. If so, supplementation with an ulnar recession procedure is warranted. On clinical examination, a positive TFCC compression test is indicative of impaction. The addition of passive pronation and supination to axial compression and ulnar deviation – the ulnocarpal stress test – (Nakamura et al., 1997) may increase its specificity. Assessment of the ulnar variance with the pronated grip view in these patients is beneficial (Tomaino, 2000). The plain radiographs should be scrutinized for degenerative or cystic lesions of the ulnar side of the lunate and the ulnar head. These lesions can also be seen in the MRI studies that are often obtained because of the TFCC tear. Finally, during arthroscopy the presence of chondral lesions of the lunate or triquetrum or lunotriquetral ligament tears are indicative of impaction. The improvement of results of debridement of the TFCC in recent years can be partially attributed to better patient selection for supplementary procedures.

Radiofrequency probes are very useful adjunctive tools in TFCC debridement. This study investigated the clinical efficacy of this modality of treatment without any relationship with the manufacturers. Radiofrequency probes work by creating a high-frequency alternating current between their tips. Heat is generated by friction of ions in the tissue treated as they try to follow this alternating current. When the temperature exceeds 100°C, water in the tissue treated is vaporized and ablation of the tissue occurs. Temperatures around 60°C lead to collagen triple helix unwinding, reduction of the length of the molecule and tissue shrinkage (Hayashi and Markel, 2001; Medvecky et al., 2001; Wallace et al., 2000). It should be kept in mind that, in contrast to electrocautery, the radiofrequency probe itself is not heated but heat is generated in the tissue. As there are no published data on irrigation fluid warming during radiofrequency probe use within the wrist, it is advisable to use the probe intermittently, a few seconds at a time, while maintaining adequate outflow. This intermittent activation of the radiofrequency probe was used in this study and was found to be safe. The probes are small in size, precise and provide coagulation and a thermal shrinkage effect in treated tissues. Compared to the lasers that have also been proposed for the same use (Blackwell et al., 2001), no special training is needed for radiofrequency probe handling, the risk of accidental damage to the hyaline cartilage is minimal and the overall cost is lower (Sherk et al., 2002). No conclusions on the cost effectiveness over classic motorized resectors can be drawn from this study. The only limitation to radiofrequency probe use is in patients with pacemakers or other implanted electronic devices.

Recognizing and treating the truly symptomatic tears and detecting patients who need a supplemental ulnar recession are important determinants of the final outcome. We believe that radiofrequency probes are safe and effective for use in TFCC debridement. Their results compare favourably to other standard methods.

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