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Original article

Ultrasound-assisted surgical release of carpal tunnel syndrome: Results of a pilot open-label uncontrolled trial conducted outside the operating theatre☆

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ABSTRACT

Objective: To confirm the feasibility of ultrasound-assisted surgical release of carpal tunnel syndrome in the interventional radiology room.
Materials and methods: Study involving 39 patients suffering from carpal tunnel syndrome confirmed by electromyogram and unresponsive to medical treatment. The patients were recruited via orthopedic surgery and rheumatology consultations and were operated on in the interventional radiology room under local anesthesia. A single approach was used, at the wrist flexion crease. Patients were monitored over a 90-day period. This is a descriptive open-label uncontrolled study.
Results: Fifteen men and 24 women, aged between 21 and 86 years, were included, 23 of whom were in work. The mean surgical procedure time was of 19.0 ± 4.6 minutes; the mean room occupancy time was of 38.0 ± 8.1 minutes and the mean volume of local anesthetic used was of 14.7 ± 2.3 cc. The score for pain, formication and discomfort experienced in the hand was significantly reduced by day 15 (49.1 ± 21.1 vs. 23.5 ± 19.5; $P < 0.001$). Eight patients continued to present with paresthesia on day15 and only 3 by day 30. Four patients had returned to work by day 15, 10 patients considered that they could have resumed work within an average of 9.9 ± 4.9 days after the procedure. Twenty-five patients estimated that they could resume their daily activities within a mean period of 7 ± 3.9 days. No postoperative complications related to the procedure were observed.
Conclusion: According to the results of this study, ultrasound-assisted surgical release of carpal tunnel syndrome performed outside the operating theatre seems to be effective and well-tolerated.

In the United States, carpal tunnel syndrome (CTS) affects 1% of the general population and 5% of the active population [1]. Carpal tunnel surgery is the most frequent of hand and wrist surgical procedures in the USA, with more than 500,000 surgical procedures per year [2]. The direct costs induced by this disease in the US are of 1 billion dollars per year [1]. CTS is responsible for a significant loss of working days (National Center for Health Statistics). According to the Bureau of Labor and Statistics and the National Institute for Occupational Safety and Health-NIOSH, CTS affects 8 million Americans and in half of these cases, the CTS is linked to professional activity. Twenty-five percent of persons working on computer keyboards suffer from CTS. Only 23% of patients operated for CTS are able to resume their previous work.

Carpal tunnel syndrome is a disease caused by compression of the median nerve. The most frequently observed symptom is a sensation of formication (or acroparesthesia) in the first 3 to 4 fingers, generally when sleeping or waking up. Other symptoms, such as numbness of the fingers or clumsiness, may also be reported.

When a surgical indication is established, two surgical approaches are currently available to treat carpal tunnel syndrome:

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the mini-open or open technique and the endoscopic technique. Both of these procedures, performed on an outpatient basis, share a common goal: flexor retinaculum section. The two techniques differ in the direction of retinaculum section. Mini-open surgery consists in performing a two to three-centimeter incision in the heel of the hand (this technique involves a partially "blind" section of the retinaculum up to 6–8 cm depending on the surgeon), followed by the section of all structures superficial to the carpal tunnel (cellulo-adipose tissue).

The initial sections of the flexor retinaculum under endoscopic control were reported in 1990. The two most frequently used techniques are single-portal techniques using Agee instruments [3] and two-portal techniques derived from the Chow technique [4]. Both of these techniques are performed in the operating theatre, under neuroleptanalgesia and local or locoregional anesthesia. The single-portal endoscopic technique requires the use of sophisticated and expensive equipment. It involves making a one to two-centimeter skin incision transversal to the proximal palmar crease of the wrist in order to insert relatively voluminous equipment. Two-portal techniques involve a five-millimeter proximal incision in the proximal palmar crease of the wrist, along with a second incision at the intersection of the axis of the third commissure with a horizontal line passing through the base of the thumb. An endoscope connected to a video control system is inserted through one of the portals, while the cutting equipment is inserted through the opposite incision.

Over the past years, the size of the incisions required for mini-open surgery has decreased significantly: it is currently of circa 1 to 2 cm. For endoscopy, distal and proximal incisions of approximately 1 cm are made. Whatever the technique used, carpal tunnel surgery complications are mainly nervous, vascular or tendinous, infections, transient neurological disturbances disappearing within 6 months, or bone complications (algodystrophy). Several recent publications have highlighted more rapid recovery when the incision is small and when the procedures are performed under endoscopic control [5–7].

The purpose of developing a new technique is to reduce the side effects associated with surgery (infection, algodystrophy, scar tissue formation), to limit the prescription of work stoppages (currently 3 to 6 weeks for a surgical procedure) and to reduce induced costs.

Carpal tunnel ultrasound has been used for many years, particularly for diagnostic and etiological purposes [8,9]. Recently, a study of the surgical release of carpal tunnel syndrome under ultrasound control was published [10]. In this study, the authors showed that the surgical release of CTS under ultrasound control gives equally satisfactory results as the mini-open technique and generates fewer postoperative complications. This technique also accelerates recovery and resumption of activity. The study involved thirty-five carpal tunnels compared in a non-random fashion to thirty-nine carpal tunnels release by the mini-open technique.

A recent study on 104 cadavers has demonstrated that when the technique is performed under ultrasound control, the portal is reduced and retinaculum section rendered more secure [11]. The approach in that study was at the wrist flexion crease rather than distal to the carpal tunnel in the palm of the hand as described by Nakamichi et al. [10]. The authors then conducted an open study in the operating theatre on 25 patients [11]. The carpal tunnel syndrome disappeared for all patients. No side effects were reported during the 3-month patient follow-up. Most patients were able to resume their professional activity rapidly, sometimes in just a few days.

Therefore, the purpose of this study was to confirm the feasibility of ultrasound-assisted surgical release of carpal tunnel syndrome (CTS) in the interventional radiology room.

1. Methods

1.1. Patients

Patients were enrolled from by non-operator physicians from rheumatology and orthopedic surgery consultations. A clinical assessment was performed by the rheumatologist. An EMG was performed as a pre-therapy assessment. The ultrasound was performed by the ultrasound specialist investigator-operator rheumatologist. After the procedure, follow-up visits were organized at 15 days (D15), 1 month (D30) and 3 months (D90) with the non-operator rheumatologist or orthopedic surgeon, with evaluation of efficacy and of iatrogenicity if any. Additional visits were scheduled if required, depending on tolerance. This is a descriptive uncontrolled study (open-label, a single arm).

1.2. Surgical procedure

Patients were managed by the radiology department in the interventional radiology room. They were placed on an interventional radiology table fitted with an arm and forearm rest. The ultrasound instrument was placed at a distance from the table with the monitor facing the operator (ESAOTE Technos Mpx, 13 MHz). An assistant (nurse) was present in the room, in addition to the operator. The operator was either an orthopedic surgeon, specialist of the hand-surgery and trained in the ultrasound, or an interventional rheumatologist. The patient was not perfused. We used a standard ultrasound instrument with 13 MHz probe. The operator had sterile gloves, surgical gown, surgical hoods and sterile gloves (Fig. 1). Before placing the sterile drapes, the various ultrasound parameters (depth, focal length, gain, etc.) were adjusted, and the limits of the carpal tunnel marked (Fig. 2),

Fig. 1. Patient and equipment installation in the interventional radiology room.

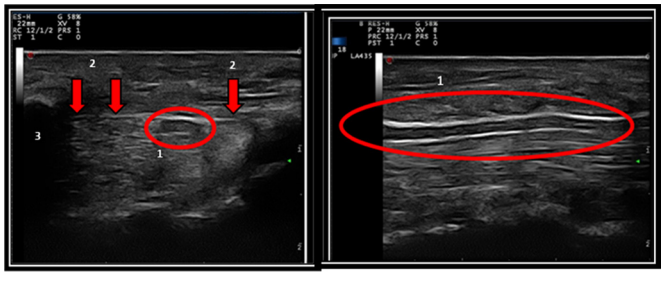

Fig. 2. Location of the median nerve (1) and flexor retinaculum (2) at the exit of the carpal tunnel, facing the hamatum hamulus (3).