Vein conduit associated with microsurgical suture for complete collateral digital nerve severance

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KEYWORDS
Vein conduit; Digital nerve sensibility; Microsurgical repair

Summary
The aim of this study is to present the long term results of a series of 53 vein conduit grafts as first line therapy to repair complete severance of one or more collateral digital nerves. The surgical technique included an epi-perineural suture of the nerve under minimal tension, associated with a vein graft harvested from the back of the hand to cover the nerve. None of the patients presented with a neuroma, spontaneous pain or had stopped using the injured finger. Sensibility results were good or very good in 67% of cases. The scar at the donor site was very light or invisible. A total of 96% of patients were satisfied or very satisfied. This simple technique, by protecting the injured nerve, results in a rate of sensory nerve recovery that is comparable or better than that of other series in the literature, without neuroma and with minimal scarring at the donor site.

Introduction
Injury to collateral digital nerves represents a significant portion of hand traumas and is associated with a risk of neuroma and significant functional sequelae. As early as 1984 in a study in the dog, Calteux et al.\cite{1} emphasized the small size of the anastomotic neuroma when it was contained by a venous sleeve, and the capacity of the latter to isolate the neuroma. We associated this technique with direct nerve suture as a first line treatment for severed digital nerves. The aim of this study was to evaluate the functional results, sensory recovery and residual pain and/or scarring with this technique.

Patients and methods
This retrospective monocentric multi-operator study included 48 patients (or 53 vein conduit grafts) presenting with recent complete severance of one or more collateral digital nerves with no substance loss or associated injuries. Complex multiple traumas including severe crushing or stretching were excluded (Fig. 1). All patients underwent emergency or semi-emergency surgery, and patients presenting more than four days after injury were excluded. The free mean interval between the trauma and surgery was 14.3 hours (1–90).
This series included 20 women and 28 men, mean age 40 years old (8—79). The mean follow-up was 25.75 months (16—39). The dominant hand was injured in 50% of the cases (24 patients). In 15 cases, the patient had been injured in a work related accident. The mechanism, location of the wound and the associated injuries were identified. Examination of the texture of the skin was performed to determine if it was thin or callous.

The results of sensory nerve recovery were evaluated by the Weber test (S2PD), the Dellon test (M2PD) [2] the 5-monofilament test and the Tinel test [3]. The presence of a neuroma, articular range of motion, feeling in and spontaneous use of the finger by the patient were noted. Sensitivity to cold was systematically investigated. Any medical history which might affect sensibility was noted: diabetes, carpal canal pathology. The size of the scar at the donor site, its appearance and the presence of adhesions were noted as well as the patient’s feeling about the scar, both in relation to pain and appearance. The scar of the initial injury was also evaluated, and any retractile adhesions were searched for. In patients with a simple pedicled injury without any associated traumas, the length of surgery and the delay before day-to-day activities were again possible were evaluated. Any complications or revision surgery were noted. Finally the patient evaluated his/her level of general satisfaction in four stages: Very satisfied, satisfied, not very satisfied, dissatisfied.

Patients were evaluated by an independent observer.

**Surgical technique**

All patients (except one) underwent surgery with locoregional anaesthesia (Figs. 2—6). After exploring, debriding and cleaning the wound, several millimetres of the injured nerve were freed proximally and distally. The venous conduit graft was harvested, usually on the dorsal side of the hand, with a short incision. If the diameter was large, the segment could be harvested from the forearm. The vein segment was slipped on one of the ends of the nerve “like a sock”. The
nerve was then sutured with two or three epi-perineural stitches (9.0 or 10.0), under microscopic control and the venous sleeve was pulled over the sutured nerve. A gap of 1–2 mm at most between the two ends of the nerve was tolerated. Patients were immobilized for 15 days in a segmented splint for an isolated injury or longer for associated injuries.

Results

None of the patients presented with neuromas, spontaneous pain or no longer used the injured finger. In 15% of the cases, a Tinel sign was found. Results of the S2PD test was a mean 10.3 mm (3–22) (Fig. 7). The mean Dellon test M2PD results were 9 mm (3–22) (Fig. 8). The best results for these tests were obtained in the youngest patient (eight years old). None of the patients detected the 2.83 filament in the 5-monofilament test with the injured finger or the healthy fingers (Fig. 9). In the telephone interview, only one patient felt that s/he had not recovered protective sensibility.

In nine patients, perception of the finger was "normal", thirty-seven of them used it in the same way as prior to injury. In patients who had changed the use of their finger, three had modified it for complicated gestures, three for those requiring strength, and one patient still had a slight avoidance reflects although the finger was used for day-to-day activities. Twenty-eight patients (58%) were bothered by cold, but there was no pain. Movement was limited in five patients, all of whom had associated tendon damage.

The venous graft was harvested (Fig. 10), from the back of the hand in 38 cases, the wrist in five cases (two on the
Vein conduit and microsurgical suture of collateral digital nerves

Vein conduit and microsurgical suture of collateral digital nerves, as recommended by Bunnel in 1956 [10], with epi-perineural artificial tubes [9]. For "simple" nerve severing, the first line of treatment is usually microsurgical by direct suture as recommended by Bunnel in 1956 [10], with epi-perineural stitches [11].

Lundborg adapted the principle of connecting nerve endings in a conduit without suture [12,13] using silicone tubes on median and ulnar nerves. The results were at least as good as classic microsurgical techniques with less intolerance to cold.

The association of direct suturing and a vein conduit has not yet been described in clinical practice as a first line treatment for severed collateral digital nerves. Our vein conduit technique must therefore be compared to other studies with direct suturing of these nerves [14—16]. Our results were at least as good as these series suggesting that there is an advantage to using this type of conduit, based on the results of the sensibility tests, the absence of a neuroma in the series and the minimal residual scarring.

Conclusion

This simple technique of vein conduit, with the protection it provides to the injured nerve, results in a rate of sensory nerve recovery that is at least comparable to other series in the literature, with no neuromas and minimal residual scarring at the donor site.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References


Discussion

The use of "tubes" of different material to treat peripheral nerve damage has thus far been described as current practice to bridge nerve gaps: arteries [6], veins [7] [8], artificial tubes [9]. For "simple" nerve severing, the first line of treatment for repair is usually microsurgical by direct suture as recommended by Bunnel in 1956 [10], with epi-perineural stitches [11].

Figure 10 Example of a scar at the vein conduit graft donor site (back of the hand).

A total of 96% of patients were satisfied or very satisfied. Four patients had carpal tunnel syndrome (one of whom was operated on six months after the trauma) and one had diabetes, which could have modified the sensibility tests.

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