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Double Fascicular Nerve Transfer From the Ulnar and Median Nerves to the Musculocutaneous Nerve for Restoration of Elbow Flexion: Surgical Technique and Preliminary Results

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Abstract

Traumatic C5-C6 brachial plexus palsies result in complete loss of elbow flexion, and restoring this function is the top priority in upper plexus reconstruction. Double fascicular nerve transfer at the brachial canal, combining an ulnar nerve fascicle transferred to the biceps branch and a median nerve fascicle transferred to the brachialis branch of the musculocutaneous nerve, is an established technique for this indication. We report a retrospective series of five consecutive patients with post-traumatic C5-C6 palsy who underwent double fascicular nerve transfer at the Department of Traumatology and Orthopedics A, Mohammed VI University Hospital, Marrakech, between January 2019 and December 2022. Of the seven patients with traumatic C5-C6 palsy assessed during this period, one declined surgery, and one was lost to follow-up before surgery; all five operated patients were included, with no postoperative loss to follow-up. All patients were operated on within three to six months of injury, and outcomes were assessed using the Medical Research Council grading scale over a mean follow-up of 20 months (range 17-23). The mean age was 35 years (range 29-43), with a male predominance (4/5), and all patients had been involved in motorcycle road traffic accidents. The mean time to clinical reinnervation (M1) was 4.0 months, and the mean time to M3 strength was 7.6 months (n = 3 patients with a recorded date); the only patient who reached M4 did so at 13.2 months. At the last follow-up, one patient had reached M4, three had reached M3, and one had reached M2: four of five patients (80%) achieved M3 or better, and one of five (20%) achieved M4 or better. Ulnar donor-site deficits, assessed clinically, were observed in two patients and persisted at final follow-up (one with persistent paresthesia and improving key pinch weakness, one with persistently reduced ulnar deviation strength), with no reported median donor-site morbidity or surgical complications. In this small preliminary series, double fascicular nerve transfer using ulnar and median nerve fascicles to the musculocutaneous nerve was feasible in our setting, with a rate of useful antigravity elbow flexion comparable to those reported in published series but a markedly lower rate of recovery to M4 strength and persistent ulnar donor-site deficits in two of five patients. Larger prospective studies are needed to confirm these findings.

Categories: Trauma, Orthopedics
Keywords: brachial plexus, elbow flexion, fascicular neurotization, musculocutaneous nerve, nerve transfer

Introduction

Traumatic brachial plexus injuries are severe and devastating neurological lesions, occurring mainly in young, active men following high-energy accidents, particularly motorcycle accidents. Their exact incidence is difficult to establish and is probably underestimated; it appears higher in regions with a high density of motorized two-wheelers [1]. The functional sequelae are considerable, causing long-term impairment of patients' quality of life and independence.

In upper brachial plexus palsies of the C5-C6 type, loss of elbow flexion is the most disabling functional deficit, as it deprives the patient of the ability to bring the hand to the mouth and substantially influences upper limb rehabilitation [2]. For this reason, restoration of elbow flexion is regarded as the priority surgical objective in the hierarchy of plexus reconstruction.

The lesional mechanisms of the brachial plexus fall into two broad categories with distinct therapeutic implications: root avulsions, which are incompatible with any direct repair, and root or trunk ruptures, which can be repaired by nerve grafting or direct suture [2]. In C5-C6 palsies with avulsion, and more generally when proximal root repair is not possible or not undertaken, intraplexal nerve transfers at the brachial canal have become a technique of choice, reducing the delay of axonal regeneration between the coaptation site and the target motor endplates and maximizing the chances of functional recovery.

The original technique underlying this approach was described by Oberlin et al. in 1994: transfer of a motor fascicle of the ulnar nerve, destined for the flexor carpi ulnaris (FCU), directly onto the biceps branch of the musculocutaneous nerve [3]. In this original description, the harvested contingent represented only a limited

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fraction of the ulnar nerve cross-section, on the order of 10% of its bulk, without significant impairment of hand function [3]. This direct fascicular neurotization, performed in the brachial canal away from the root lesions, considerably reduces the delay of axonal regeneration by bringing the coaptation site closer to the target motor endplates, compared with the classic extraplexal transfers (accessory nerve, intercostal nerves, phrenic nerve) [3,4].

The evolution of this technique led to the development of double fascicular nerve transfer at the brachial canal, which adds a median nerve fascicle transfer to the ulnar nerve transfer, destined for the extrinsic flexor muscles of the hand, transferred to the motor branch to the brachialis arising from the musculocutaneous nerve. This strategy, codified by Mackinnon et al. [5] and subsequently evaluated in a larger series by Ray et al. (29 cases) [6], aims to achieve a more complete recovery by simultaneously reinnervating the two main elbow flexors without significant additional donor-nerve morbidity.

We report here our preliminary experience in a series of five patients operated on at the Department of Traumatology and Orthopedics A, Mohammed VI University Hospital, Marrakech, between 2019 and 2022. This study has two objectives: to describe in detail the double fascicular nerve transfer technique at the brachial canal and to report preliminary functional results and compare them with data from the international literature.

Case Presentation

Study design and population

This is a retrospective descriptive study of five consecutive patients managed surgically at the Department of Traumatology and Orthopedics A (Ibn Tofail Hospital, Mohammed VI University Hospital, Marrakech, Morocco) over a four-year period, from January 1, 2019, to December 31, 2022. The study was conducted in accordance with the principles of the Declaration of Helsinki; approval from the local ethics committee and informed consent from patients were obtained.

Inclusion and exclusion criteria

Patients were included if they presented with (i) a traumatic upper brachial plexus palsy involving the C5-C6 or C5-C6-C7 roots, with complete or subtotal loss of elbow flexion; (ii) concordant clinical and electrophysiological findings; (iii) surgical management within six months of the initial trauma; and (iv) a postoperative follow-up of at least 12 months. Patients were excluded if they had complete brachial plexus palsy (C5-T1), bilateral involvement, previous ipsilateral plexus surgery, associated joint lesions that contraindicate rehabilitation, or postoperative follow-up of less than 12 months (Table *1*).

Criterion type	Criterion
Inclusion	Upper brachial plexus palsy of C5-C6 or C5-C6-C7 topography, of traumatic origin, with complete or subtotal deficit of elbow flexion
Inclusion	Concordant electrophysiological and clinical findings
Inclusion	Surgical management within six months or less after the initial trauma
Inclusion	Postoperative follow-up of at least 12 months
Exclusion	Complete brachial plexus palsy (C5 to T1)
Exclusion	Bilateral involvement
Exclusion	Previous ipsilateral plexus surgery
Exclusion	Associated joint lesions contraindicating rehabilitation
Exclusion	Postoperative follow-up shorter than 12 months

TABLE 1: Inclusion and exclusion criteria of the study

Patient selection

Between January 1, 2019, and December 31, 2022, seven patients with traumatic brachial plexus injury were assessed in our department, all presenting with an upper-type C5-C6 palsy. Two patients were not operated on: one declined surgery, and one was lost to follow-up during the preoperative work-up. The remaining five patients all underwent double fascicular nerve transfer; no other reconstructive technique was used for

this indication during the study period. All five operated patients completed the minimum 12-month follow-up and were included in the analysis, with no postoperative exclusions. The study population therefore comprises all consecutive patients operated on with this technique during the study period (Figure *1*).

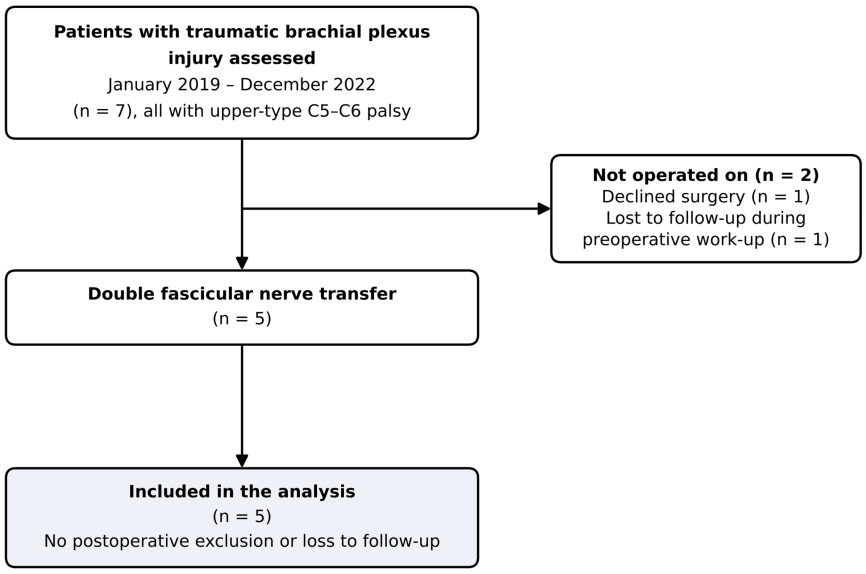


FIGURE 1: Flow diagram of patient selection

Postoperative management

Body-to-elbow immobilization (Gilchrist-type bandage) was maintained for three to four weeks in the immediate postoperative period to protect the nerve coaptation sites. At the end of this period, patients were referred to a specialized physiotherapist for a program of progressive functional rehabilitation, incorporating mental stimulation of the target movements, proprioceptive work, and cortical integration.

Outcome assessment

Functional outcomes were assessed using the Medical Research Council (MRC) scale (grades 0 to 5) at each follow-up visit [7]. The operational definitions used were as follows: M0, no visible or palpable contraction; M1, first clinically palpable muscle contraction; M2, visible contraction with gravity eliminated; M3, active elbow flexion against gravity; M4, flexion against moderate resistance; M5, normal strength. A result of M3 or better was considered clinically satisfactory [4,6]. Donor-site morbidity was assessed in terms of sensory and motor deficits. Data were retrieved from the patients' clinical records and follow-up consultation notes, in which the MRC grade of elbow flexion was documented at each visit; the time to each grade was defined as the interval between surgery and the first visit at which that grade was recorded. The primary outcome was the proportion of patients reaching each grade at final follow-up, with the whole series (n = 5) as the denominator; times to reach a grade are reported as descriptive data, with the number of contributing patients specified.

Epidemiological data

The series comprised five patients (Table *2*). The mean age was 35 years, with a clear male predominance (four men and one woman, i.e., 80%). In all cases, the etiology was a road traffic accident involving a motorcycle, with helmet use documented in all patients. All five patients had an isolated C5-C6 palsy; although the inclusion criteria allowed C5-C6-C7 injuries, no such patient presented during the study period.

Parameter	Results (n = 5)
Mean age (years)	35 years (range 29-43)
Sex	4 men/1 woman (80% male)
Etiology	5 motorcycle RTAs (100%)
Helmet use	5/5 (100%)
Type of palsy	Isolated C5-C6 (5/5); no C5-C6-C7
Lesion type (avulsion/rupture)	Not determined (MRI unavailable; no supraclavicular exploration)
Time from trauma to surgery	Mean 4.8 months (range 3-6)
Mean postoperative follow-up	20 months (range 17-23)

TABLE 2: Demographic and clinical characteristics of the series (n = 5)

RTA: road traffic accident

Preoperative assessment

The preoperative evaluation systematically comprised (1) a complete clinical examination with a comprehensive neurological assessment and grading of muscle strength according to the MRC scale, together with a search for neuropathic pain; (2) an electromyogram (EMG) with nerve conduction study, performed between one and three months after the initial trauma, to assess the severity of the injury and guide the surgical indication; and (3) standardized cervical spine radiographs and a standard preoperative laboratory work-up. Cervical MRI, recommended for detecting root avulsions (pseudomeningoceles), could not be obtained in any patient because it was unavailable in our setting during the study period.

In all patients, EMG demonstrated massive denervation of the C5-C6 muscles, with no voluntary motor unit activity in the biceps or brachialis muscles. These electrophysiological data, combined with the severity of the clinical deficit and the absence of spontaneous recovery in the weeks following the trauma, confirmed the indication for surgical neurotization. The electrophysiological examination also confirmed the functional integrity of the donor nerves (ulnar nerve and median nerve), a prerequisite for the success of the technique.

Clinically, all patients presented with complete loss of elbow flexion, with preserved ulnar and median nerve function and no spontaneous recovery at the time of the surgical decision. Without MRI and supraclavicular exploration of the roots, the preganglionic (avulsion) or postganglionic (rupture) nature of the root lesions could not be determined. The indication for distal intraplexal transfer was therefore based on the clinical and electrophysiological findings, the absence of spontaneous recovery three to six months after injury, and the aim of reinnervating the elbow flexors as quickly as possible, regardless of lesion type.

Operative technique

Positioning and Anesthesia

The procedure is performed under general anesthesia, with the patient in a supine position, the head turned to the side contralateral to the procedure, and the upper limb in 60-70° abduction and neutral rotation on a dedicated arm table. The operative field extends from the ear to the hand. A pneumatic tourniquet is not used to preserve the quality of the intraoperative neurostimulation signals.

Surgical Approach

The skin incision begins over the deltopectoral groove, continues distally along the axis of the medial brachial canal, then curves slightly medially as it approaches the elbow crease. A counter-incision is made at the level of the elbow crease to expose the terminal branches of the musculocutaneous nerve. Subcutaneous dissection allows the superficial venous and lymphatic structures to be retracted, the brachial fascia to be exposed, and the medial brachial canal to be entered. No supraclavicular exploration of the roots was performed; the entire procedure was carried out through this brachial approach.

Localization and Identification of the Nerve Structures

The brachial neurovascular bundle is exposed within the brachial canal. The brachial artery is identified and retracted medially. The median nerve runs anterior and slightly lateral to the artery; the ulnar nerve is

identified posterior to the medial intermuscular septum. The musculocutaneous nerve is located at its exit from the coracobrachialis, anterior to the biceps brachii, and is followed to its point of division into a motor branch to the biceps (superficial and lateral) and a motor branch to the brachialis (more distal and deep). Intraoperative neurostimulation (low-intensity nerve stimulator, 0.5-1.0 mA) is used systematically to confirm the functional identity of each structure (Figure *2*).

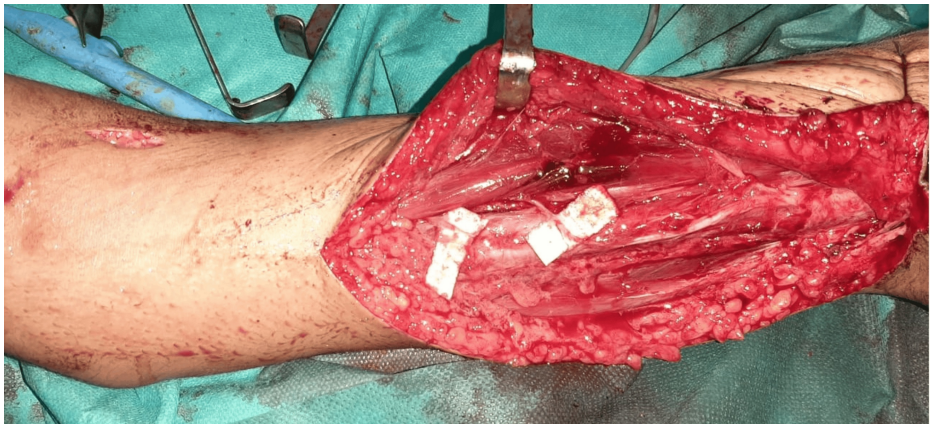


FIGURE 2: Anatomy of the brachial canal: exposure of the donor and recipient nerves.

Neurotization of axonal fascicles from the ulnar and median nerves onto the musculocutaneous nerve.

Ulnar-to-Biceps Branch Neurotization

Under loupe magnification (×3.5 to ×4.5), interfascicular dissection of the ulnar nerve is carried out over 4 to 5 cm. Neurostimulation allows the fascicles destined for the intrinsic muscles of the hand and the ulnar sensory fascicles to be identified and formally preserved. The anteromedial motor fascicles, whose stimulation elicits contraction of the FCU without any measurable sensory response, are transected distally with microsurgical scissors. This harvest is deliberately limited to the motor component of the FCU, preserving most of the ulnar nerve cross-section [3,4].

The motor branch of the musculocutaneous nerve to the biceps is transected as distally as possible. Direct, tension-free coaptation is performed between the donor ulnar fascicles and the recipient biceps branch, using epineural sutures with 8-0 or 9-0 non-absorbable monofilament, under a loupe or operating microscope (Figure *3*).

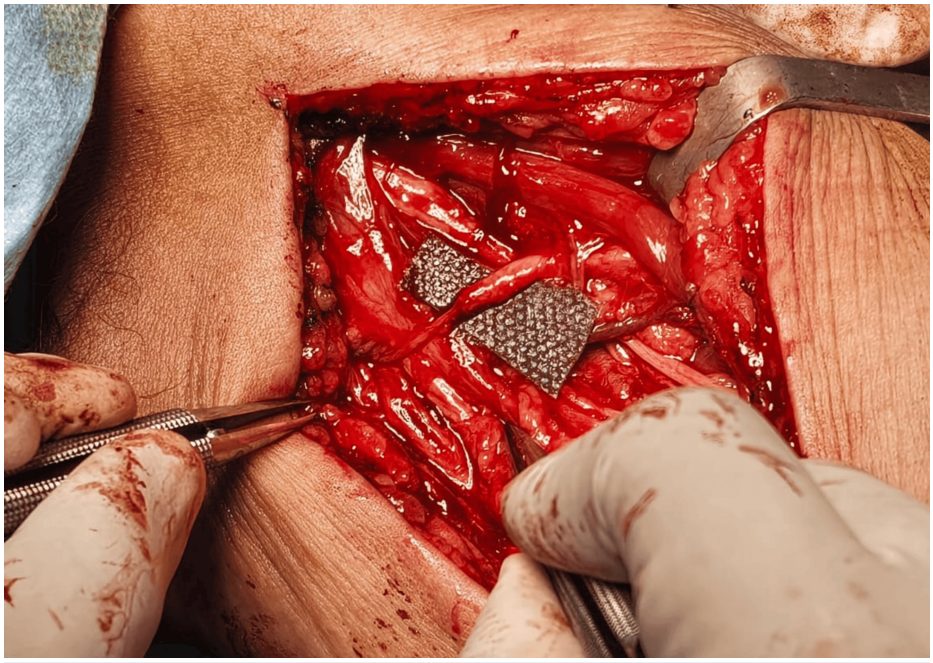


FIGURE 3: Fascicular dissection for double fascicular nerve transfer

The donor fascicles are individualized and isolated on separate contrasting background strips in preparation for double fascicular coaptation; fine interfascicular dissection is performed with microsurgical forceps.

Median-to-Brachialis Branch Neurotization

Interfascicular dissection of the median nerve is carried out using the same technique. An expendable motor fascicle destined for the flexor carpi radialis is identified by neurostimulation and then harvested, favoring an expendable fascicle to limit donor-site morbidity. The sensory fascicles and the fascicles destined for the thenar muscles are systematically preserved.

Dissection of the musculocutaneous nerve continues distally until precise identification of its motor branch to the brachialis. The counter-incision at the elbow crease is essential to distinguish this branch from the sensory branch, which will become the lateral antebrachial cutaneous nerve, and to spare it. Direct coaptation is then performed with 8-0 or 9-0 sutures (Figure *4*).

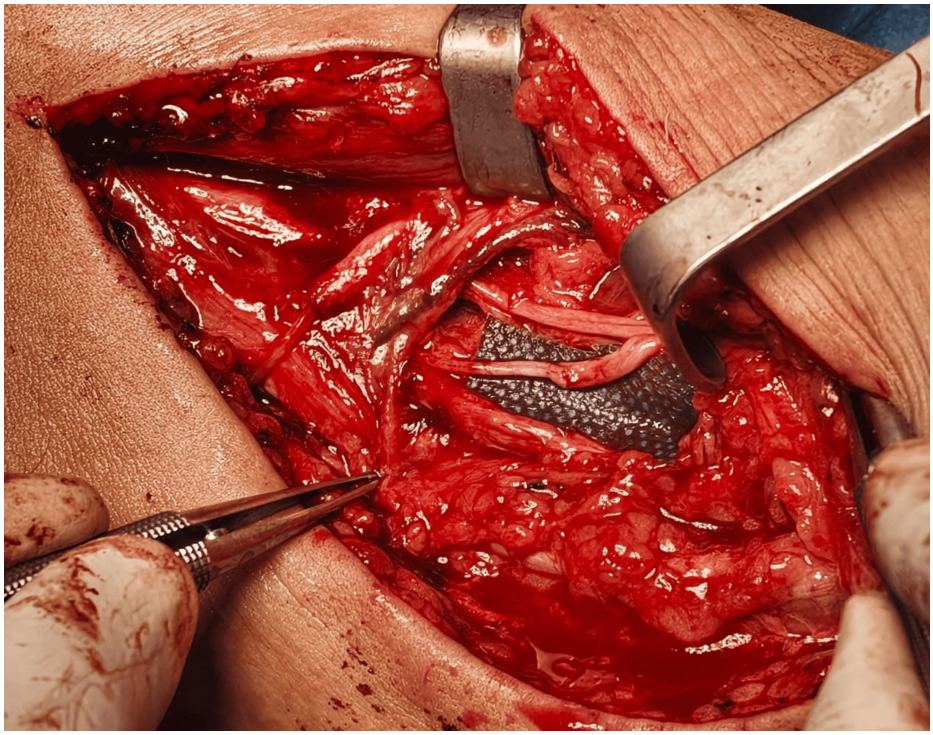


FIGURE 4: Detail of the fascicular coaptation

Direct fascicular coaptation for the neurotization of axonal fascicles from the ulnar and median nerves onto the musculocutaneous nerve (biceps and brachialis branches), performed tension-free on a contrasting background strip under retraction.

Closure

After careful hemostasis and irrigation with normal saline, closure is performed in anatomical layers: brachial fascia with 2-0 absorbable suture, subcutaneous tissue with 3-0 absorbable suture, and skin with interrupted sutures or an intradermal running suture. A compressive dressing and body-to-elbow immobilization are applied.

Functional outcomes

Individual patient data are presented in Table *3* and summarized in Table *4*. The first palpable muscle contraction (grade M1) was observed at a mean of 4.0 months postoperatively (range 3.7-4.1; n = 5). M3 strength, allowing active elbow flexion against gravity, was achieved at a mean of 7.6 months (range 7.4-7.9; n = 3); four patients reached M3 or better, but the date at which M3 was first recorded could not be retrieved for one of them (patient 1), and this value was not imputed. Mean follow-up was 20 months (range 17-23); all five patients were therefore followed beyond 13.2 months and could be assessed for M4. At last follow-up, one patient had reached M4, three patients had reached M3, and one patient had reached M2. Thus, four of five patients (80%) recovered useful antigravity elbow flexion (M3 or better), and one of five (20%) achieved M4 or better. The only patient who reached M4 did so at 13.2 months; the four patients who had not reached M4 by their final visit (17 to 22 months) were not assigned a time to M4 and are included in the denominator of the M4 rate. The patient who remained at M2 was still improving at last follow-up. These results should be interpreted in light of the small sample size.

Pt	Age/sex	Delay to surgery (mo)	EMG findings	Lesion type	M1 (mo)	M3 (mo)	M4 (mo)	Final MRC grade	Follow-up (mo)	Donor-site morbidity
1	29/M	6	Complete C5-C6 denervation	ND	4.0	NR	-	M3	21	None
2	43/M	5	Complete C5-C6 denervation	ND	3.7	7.9	-	M3	17	Reduced ulnar deviation strength (persistent)
3	38/F	6	Complete C5-C6 denervation	ND	4.1	7.6	13.2	M4	23	None
4	35/M	3	Complete C5-C6 denervation	ND	4.1	7.4	-	M3	17	Ulnar-border paresthesia (persistent) + key pinch weakness (improving)
5	30/M	4	Complete C5-C6 denervation	ND	4.0	-	-	M2	22	None

TABLE 3: Individual patient data

Time to M4 is reported only for patients who achieved this grade; otherwise, it is indicated as "-." No voluntary motor units were detected in the biceps or brachialis muscles, and ulnar and median nerve conduction were normal in all patients.

Pt: patient, mo: months, MRC: Medical Research Council, NR: not recorded, ND: not determined (magnetic resonance imaging unavailable; no supraclavicular exploration)

Assessment parameter	Results
Mean time to clinical reinnervation (M1)	4.0 months (range 3.7-4.1; n = 5)
Mean time to M3 grade	7.6 months (range 7.4-7.9; n = 3)
Time to M4 grade	13.2 months (n = 1)
Recovery ≥M3	4/5 (80%): 1 M4, 3 M3
Recovery ≥M4	1/5 (20%)
Final grade below M3	1/5 (M2, still improving at last follow-up)
Ulnar donor site - sensory and motor	1/5 (patient 4): paresthesia of the ulnar border of the hand and little finger (persistent) and weakness of thumb-to-finger (key) pinch (improving)
Ulnar donor site - motor	1/5 (patient 2): reduced wrist ulnar deviation strength (persistent)
Morbidity - median donor site	None (0/5)
Surgical complications	None (0/5)
Reoperations	None (0/5)

TABLE 4: Functional results and donor-site morbidity (n = 5)

Time to M3 is a mean among the three patients with a recorded date (four patients reached M3 or better; date not recorded for one); time to M4 is that of the single patient who reached it.

MRC: Medical Research Council

Donor-site morbidity

Donor-site morbidity was identified in two distinct patients (2/5, 40%), both at the ulnar donor site. Strength was assessed by manual muscle testing in comparison with the contralateral side; no formal grade was recorded in the clinical notes, and no instrumented measurement (pinch gauge or dynamometer) was performed. Sensory disturbances were patient-reported, without formal sensory testing. In both patients,

the deficits appeared in the early postoperative period. (1) Patient 4 had combined sensory and motor deficits: paresthesia of the ulnar border of the hand and the little finger, and weakness of thumb-to-finger (key) pinch compared with the contralateral side. The latter reflects weakness of the ulnar-innervated intrinsic muscles (adductor pollicis, first dorsal interosseous) and indicates that the fascicles destined for the intrinsic muscles were affected despite their intended preservation. At final follow-up (17 months), the pinch weakness was improving, whereas the paresthesia persisted. (2) Patient 2 had an isolated motor deficit: reduced wrist ulnar deviation strength compared with the contralateral side, attributed to fascicular harvesting from the FCU contingent of the ulnar nerve; this deficit persisted at final follow-up (17 months). No median donor-site morbidity was observed. No infectious, vascular, or wound-healing complication was recorded. No reoperation was required.

Discussion

Principal findings

In this series of five consecutive patients with traumatic C5-C6 palsy treated with double fascicular transfer, four of five patients (80%) recovered antigravity elbow flexion (M3 or better), and one of five (20%) reached M4, after a mean follow-up of 20 months; one patient remained at M2 but was still improving at the last follow-up. Ulnar donor-site deficits were observed in two patients and persisted, at least partially, at final follow-up; no median donor-site morbidity was recorded.

Recovery compared with published series

Since the original description of ulnar fascicular transfer to the biceps branch by Oberlin et al. [3], single transfer has yielded M3 or better recovery in about 97% of the 32 patients reported by Leechavengvongs et al. [4], and double transfer, codified by Mackinnon et al. [5], has yielded M4 or better recovery in all six of their patients and in 23 of the 29 patients reported by Ray et al. (Table 5) [6]. Our rate of M3 or better (80%) is in keeping with these series, bearing in mind that, in a series of five, a single patient changes the rate by 20 percentage points. By contrast, our rate of M4 or better (20%) is markedly lower. Possible explanations include the learning curve of the technique in our center; a time to surgery of up to 6 months, at the upper limit of the recommended window; the absence of MRI and root exploration, which may have masked more severe or more extensive lesions; possible differences in the intensity and duration of rehabilitation; and a follow-up that may have been too short to capture further strength gains, as recovery after nerve transfer may continue beyond the second postoperative year. The relatively young age of our patients (mean 35 years), a favorable prognostic factor [1], is unlikely to explain this difference.

Series (year)	n	Technique	Final MRC grades at last follow-up	Recovery ≥ M3	Recovery ≥ M4
Oberlin et al. (1994) [3]	4	Single: ulnar → biceps	NR (seminal study)	NR	NR
Leechavengvongs et al. (1998) [4]	32	Single: ulnar → biceps	30 M4; 1 M3	≈97%	30/32 (94%)
Mackinnon et al. (2005) [5]	6	Double: ulnar + median	All M4+	100%	6/6 (100%)
Ray et al. (2011) [6]	29	Double: ulnar + median	8 M5; 15 M4; 4 M3	≈93%	23/29 (79%)
Current case (2019-2022)	5	Double: ulnar + median	1 M4; 3 M3; 1 M2	4/5 (80%)	1/5 (20%)

TABLE 5: Comparison of results with the main published series

Final grades and rates are drawn from the data reported in the cited publications. Unlike the reference series, our series also reports mean times to reach each grade.

NR: not reported

Our mean times to M1 (4.0 months) and M3 (7.6 months, n = 3) fall within the range classically reported for intraplexal transfers, with useful flexion usually observed within 12 to 18 months [8]; however, the reference series report final grades rather than times to each grade, which limits direct comparison. Finally, the superiority of double over single transfer remains debated: a systematic review with meta-analysis found no significant difference in the rate of M4 or better recovery [9], and our uncontrolled series cannot address this question.

Donor-site morbidity

Ulnar donor-site deficits were observed in two of five patients (40%), a higher rate than the approximately 5% to 20% reported in larger series [8,9]. Although a single case changes this percentage by 20 points in a series of five, the key pinch weakness of patient 4 indicates that the fascicles destined for the intrinsic muscles were not fully spared, possibly owing to traction or compression neurapraxia during dissection or to fascicular overlap, in the context of the learning curve. This underlines the importance of identifying and protecting the deep motor fascicles destined for the intrinsic muscles by neurostimulation before any fascicular section [3,8]. The absence of median donor-site morbidity is consistent with published data [5,6]. As these deficits were assessed by manual testing only, their severity could not be quantified.

Study limitations

This study has several limitations inherent to its retrospective nature and the small size of the series. First, the small sample size (n = 5) does not allow comparative statistical analyses and introduces a potential risk of selection bias. Second, the mean follow-up of 20 months, although sufficient to appraise midterm results, does not permit conclusions about long-term durability. Third, the absence of a control group treated with single neurotization limits the scope of comparisons. Fourth, two of the seven patients assessed were not operated on (one refusal and one lost to follow-up before surgery). However, all operated patients were included with no postoperative loss to follow-up; the small number of patients seen limits the representativeness of the series. Fifth, outcomes were assessed with the MRC scale alone, without dynamometric strength measurement or patient-reported outcome measures; additionally, the time to M4 (13.2 months) was recorded for only one patient, the date at which M3 was first recorded could not be retrieved for one patient, and the follow-up may have been too short to capture late strength gains, as illustrated by the patient who was still improving at last follow-up. Sixth, cervical MRI was unavailable, and no supraclavicular exploration was performed, so the lesion type (avulsion or rupture) could not be determined; some patients may therefore have had ruptures amenable to grafting, and the lesion type could not be correlated with outcomes. Seventh, donor-site morbidity was assessed by manual muscle testing only, without formal grading or instrumented measurement, and sensory disturbances were patient-reported, precluding objective quantification of their severity.

Implications for future data collection

These limitations define the data that a prospective study of this technique should collect: MRC grading of elbow flexion at predefined intervals (e.g., three, six, nine, 12, 18, and 24 months); instrumented measurement of elbow flexion, key pinch, and wrist strength with a dynamometer and pinch gauge, compared with the contralateral side; formal sensory testing of the donor territories; patient-reported outcomes (DASH or QuickDASH); cervical MRI and, where feasible, root exploration to classify the lesion; and a minimum follow-up of 24 months. Given the small number of patients treated at a single center, a multicenter registry would be needed to reach a sample size that allows comparison between single and double transfers.

Conclusions

The fundamental value of intraplexal fascicular neurotizations lies in their ability to bring the front of axonal regrowth as close as possible to the target motor endplates, reducing the delay of muscle denervation and maximizing the chances of functional recovery. Double fascicular nerve transfer at the brachial canal, combining the transfer of an ulnar nerve fascicle to the biceps branch and of a median nerve fascicle to the brachialis branch of the musculocutaneous nerve, represents, for our team and many others internationally, one of the reference techniques for restoring elbow flexion in upper brachial plexus palsies. Our preliminary series of five cases supports the feasibility of this technique in our setting, with a rate of useful antigravity elbow flexion comparable to published series (M3 or better in four of five patients, 80%) but a lower rate of M4 strength (one of five, 20%). Persistent ulnar donor-site deficits in two of five patients represent a clinically relevant finding, higher than reported in larger series, and should be weighed when considering this technique.

The success of this procedure rests on three pillars: rigorous fascicular dissection guided by intraoperative neurostimulation, high-quality tension-free nerve coaptation, and intensive postoperative rehabilitation oriented toward cortical plasticity. Prospective multicenter studies with larger sample sizes remain necessary to confirm these results and to identify predictors of successful outcomes in our population.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Ilyass Issoual, Mohamed Habbab, Abdesslam Achkoun, Rachid Chafik, Oussama Badredine

Acquisition, analysis, or interpretation of data: Ilyass Issoual, Mohamed Habbab, Abdesslam Achkoun, Rachid Chafik, Oussama Badredine

Drafting of the manuscript: Ilyass Issoual, Mohamed Habbab, Abdesslam Achkoun, Rachid Chafik, Oussama Badredine

Critical review of the manuscript for important intellectual content: Ilyass Issoual, Mohamed Habbab, Abdesslam Achkoun, Rachid Chafik, Oussama Badredine

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Disclosures

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