The Surgical Landscape of Upper Limb Compressive Neuropathies in Malaysia: A One-Year Epidemiological Audit from A National Tertiary Referral Center

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Abstract

Introduction: Upper limb compressive neuropathies represent a substantial clinical and economic burden within hand and microsurgery. Despite the high volume of surgical decompressions performed in Malaysian public healthcare settings, no baseline epidemiological data exists regarding the demographic characteristics, disease patterns, or surgical workload associated with these conditions. This study aimed to define the surgical landscape and clinical profile of patients undergoing decompression for upper limb nerve entrapments at a national tertiary referral center in Malaysia.

Methods: We conducted a retrospective cross-sectional audit of all adult patients (≥18 years) who underwent primary surgical decompression for upper limb compressive neuropathies at the Hand and Microsurgery Unit of Hospital Selayang between January 1, 2024, and December 31, 2024. Data extracted from electronic medical records included demographic variables, clinical presentations, comorbidities, electrodiagnostic findings, intraoperative pathological findings, and surgical procedures performed.

Results: A total of 53 upper extremities in 53 patients were analyzed. The mean age was 48.3 ± 14.4 years, with a female preponderance (60.4%). Occupational association was identified in 84.9% of cases. Patients presented with a mean symptom duration of 4.0 ± 3.8 years. Carpal tunnel syndrome (CTS) constituted the overwhelming majority (83.0%) of diagnoses, followed by isolated cubital tunnel syndrome (7.5%). Simple open carpal tunnel release was the most frequently performed procedure (81.1%). Intraoperatively, 94.3% of patients demonstrated nerve swelling, and 81.1% exhibited pale nerve discoloration.

Conclusion: This first epidemiological audit of upper limb compressive neuropathies in Malaysia reveals a surgical landscape dominated by late-presenting, occupationally associated carpal tunnel syndrome with significant delays to surgery. These findings establish a foundational dataset for service planning and highlight the urgent need for standardized care pathways and prospective outcomes research in the Southeast Asian region.

Keywords: Carpal Tunnel Syndrome, Cubital Tunnel Syndrome, Epidemiology, Malaysia, Peripheral

Nerve Compression

1. Introduction

Upper limb compressive neuropathies constitute a significant clinical burden within the subspecialty of hand and microsurgery, representing the most common peripheral nerve disorders encountered in orthopedic and neurosurgical practice [1]. These conditions arise from chronic extrinsic pressure on peripheral nerves at specific anatomical tunnels, resulting in a debilitating clinical syndrome characterized by sensory disturbances (paresthesiae, numbness), chronic neuropathic pain, progressive motor weakness, and ultimately, profound functional impairment [2]. The most frequently encountered entrapment neuropathies include carpal tunnel syndrome (CTS), cubital tunnel syndrome (CuTS), Guyon‘s canal syndrome, and radial tunnel syndrome [3]. When conservative management fails to halt neurological decline or alleviate symptoms, surgical decompression becomes necessary to prevent irreversible nerve damage and restore upper limb function.

Globally, the incidence and prevalence of these neuropathies are well-documented, with CTS alone affecting approximately 3-5% of the general adult population in Western cohorts [4, 5]. However, there exists a stark scarcity of localized epidemiological data within the Southeast Asian context, particularly regarding surgically treated cases in Malaysian public hospitals. This knowledge gap is not merely an academic deficit but a clinical necessity, as institution-specific and region-specific epidemiological data serve as the bedrock for effective service planning, strategic resource allocation (including operating theatre utilization and manpower training), and the design of evidence-based patient care pathways.

At Hospital Selayang, a major tertiary referral center for hand and microsurgery in the country, while surgical decompressions are performed frequently, the absence of a consolidated epidemiological review hinders the ability of the Hand and Microsurgery Unit to optimize resource management and develop robust, outcome-based prospective studies. Furthermore, without a clear description of patient demographics (such as age, sex, laterality, and comorbidity profiles) and the specific distribution of nerve involvements, it is difficult to identify high-risk groups, predict surgical demand, or tailor preoperative investigation protocols effectively.

Despite being a high-volume center for peripheral nerve surgery, Hospital Selayang, and by extension, the Malaysian public healthcare system, lacks baseline epidemiological data on upper limb compressive neuropathies. This absence of local data impedes the development of targeted preventive strategies, delays in diagnosis and treatment, and suboptimal resource allocation. This study addresses this critical data gap with the following objectives: (1) to determine the demographic and clinical profile of adult patients undergoing surgical decompression for upper limb compressive neuropathies at Hospital Selayang; (2) to describe the distribution of different entrapment neuropathies and the specific nerves involved; (3) to document the types of surgical procedures performed; and (4) to identify the clinical, electrodiagnostic, and intraoperative characteristics of these patients. By providing the first comprehensive epidemiological profile of its kind in Malaysia, this research establishes a foundational dataset essential for enhancing surgical delivery and informing future clinical research in peripheral nerve surgery.

2. Methods

Study Design and Setting

This study was designed as a retrospective, cross-sectional epidemiological audit aimed at capturing a comprehensive one-year snapshot of surgical trends for upper limb compressive neuropathies. The study

was conducted within the Hand and Microsurgery Unit of the Department of Orthopaedics at Hospital Selayang, a premier tertiary referral center located in Selangor, Malaysia. Hospital Selayang serves as a national referral hub for complex hand and microsurgical cases, receiving referrals from primary health clinics and district hospitals across the country. By reviewing medical records from January 1, 2024, to December 31, 2024, this study provides a focused, contemporary analysis of surgical workloads in a high-volume public healthcare setting.

The study population encompassed all consecutive adult patients, aged 18 years and above, who underwent surgical decompression for upper limb peripheral nerve compressive neuropathies during the defined study period. All surgeries were performed by or under the direct supervision of consultant hand and microsurgeons within the specialized Hand and Microsurgery Unit.

The study included all patients aged ≥18 years with a confirmed clinical and electrodiagnostic diagnosis of upper limb compressive neuropathy who underwent primary surgical decompression. Only cases operated on by the Hand and Microsurgery Unit within the study period were analyzed. Only 53 patients underwent surgical intervention.

To isolate primary compressive neuropathies and avoid confounding variables, the study excluded: (1) patients under 18 years of age; (2) those with traumatic nerve injuries requiring repair or reconstruction; (3) cases of tumor-related nerve compressions (e.g., neurilemmoma, lipoma); (4) isolated cervical radiculopathy without evidence of peripheral nerve entrapment; and (5) revision decompression surgeries (i.e., re-operations for persistent or recurrent symptoms following previous surgical release). These exclusions were implemented to ensure a homogeneous cohort of primary entrapment neuropathies.

Data were meticulously extracted from the hospital's Electronic Medical Records (EMR) system and a standardized, pre-piloted data collection form was used to ensure consistency across all reviewed cases. The extraction process captured a robust set of variables organized into four domains; (i) demographic variables: Age, sex, ethnicity, and occupational status (occupational-related vs. non-occupational-related, based on documented clinical assessment of work-related repetitive strain), (ii) clinical profile: Specific diagnosis, nerve involvement (median, ulnar, radial, or combined), laterality (right, left, or bilateral), documented duration of symptoms (in years), and relevant comorbidities (diabetes mellitus, hypothyroidism, rheumatoid arthritis), (iii) preoperative assessment: Clinical presentation (numbness, pain, weakness), history of conservative management, preoperative functional status as measured by the Quick Disabilities of the Arm, Shoulder and Hand (QuickDASH) questionnaire, clinical examination findings (sensory and motor involvement), and nerve conduction study results (presence of sensory and motor latency), (iv) surgical and intraoperative details: type of surgical procedure performed, and intraoperative findings documented in the operative report (presence of thickened transverse carpal ligament, adhesions, pale nerve discoloration, and nerve swelling).

Quantitative data were processed using SPSS statistical software (version 26.0, IBM Corp., Armonk, NY, USA). Continuous variables were first assessed for normality of distribution using the Shapiro-Wilk test. All variables following a normal distribution were expressed as mean ± standard deviation (SD). Categorical variables were presented as absolute frequencies (n) and percentages (%) to clearly illustrate the distribution of neuropathy types, demographic patterns, comorbid conditions, and the monthly surgical volume at the hospital.

3. Results

Demographic and Baseline Characteristics

A total of 53 upper extremities in 53 patients underwent surgical intervention for compressive neuropathies during the one-year study period. The mean age of the cohort was 48.3 ± 14.4 years (range, 19-78 years). There was a female preponderance, with 60.4% (n=32) of patients being female and 39.6% (n=21) male. An occupational association was identified in the clinical records of 84.9% (n=45) of patients, while 15.1% (n=8) were classified as non-occupational (table 1).

Table 1: Demographic data

Demographic		
Age		48.3 (14.4)*
Gender		
	Male	32 (60.4)^
	Female	21 (39.6) ^
Ethnicity		
	Malay	34 (64.2) ^
	Chinese	13 (24.5) ^
	Indian	5 (9.4) ^
	Others	1 (1.9) ^
Causes		
	Occupational related	45 (84.9) ^
	Non-occupational related	8 (15.1) ^
Nerve involvement		
	Isolated median nerve	44 (83) ^
	Isolated ulnar nerve	4 (7.5) ^
	Median and ulnar nerve	3 (5.7) ^
	Median and ulnar nerve	2 (3.8) ^

Table 1 demonstrate the demographic of peripheral nerve injury underwent surgical intervention in Hospital Selayang

* expressed in mean (standard deviation)

^ expressed in frequency (percentage)

Patients presented with a remarkably long mean duration of symptoms prior to surgical consultation, averaging 4.0 ± 3.8 years (range, 1-16 years). Regarding comorbidities, diabetes mellitus was present in 28.3% (n=15) of patients, hypothyroidism in 5.7% (n=3), and rheumatoid arthritis in 3.8% (n=2).

Clinical Presentation and Preoperative Status

The most common presenting symptom was numbness, reported by 90.6% (n=48) of patients, followed by pain in 66.0% (n=35) and subjective upper limb weakness in 58.5% (n=31). All patients in the cohort had failed at least three months of conservative management prior to being listed for surgery. The mean preoperative Quick DASH score, reflecting the degree of upper limb functional impairment, was 69.7 ± 21.0 (range, 38.6-95.5), indicating substantial disability.

On clinical examination, all patients (100%) demonstrated sensory involvement (diminished sensation or paresthesiae in the affected nerve distribution), while 69.8% (n=37) had demonstrable motor involvement (e.g., thenar weakness or atrophy for median nerve entrapments).94.3% (n=50) demonstrated positive Tinel sign. Preoperative nerve conduction studies confirmed the diagnosis in all patients: 100% (n=53) demonstrated prolonged sensory latency across the involved nerve segment, and 84.9% (n=45) demonstrated prolonged motor latency.

Distribution of Neuropathies and Surgical Procedures

Isolated distal median nerve entrapment at the carpal tunnel (carpal tunnel syndrome) was the overwhelming diagnosis, accounting for 83.0% (n=44) of all cases. Isolated ulnar nerve entrapment at the cubital tunnel (cubital tunnel syndrome) constituted 7.5% (n=4) of cases. Combined median and ulnar nerve entrapments (carpal tunnel syndrome with Guyon's canal syndrome) were observed in 5.7% (n=3) of patients. Combined median and radial nerve entrapments (carpal tunnel syndrome with radial tunnel syndrome) were present in 3.8% (n=2) of patients.

Corresponding to these diagnoses, the most frequently performed surgical procedure was simple open carpal tunnel release, performed in 81.1% (n=43) of patients. Combined carpal tunnel release with Guyon's canal release was performed in 3.8% (n=2) of patients, while isolated Guyon's canal release was performed in 1.9% (n=1). Notably, 13.2% (n=7) of patients underwent complex nerve reconstruction surgery.

Intraoperative Findings

Intraoperative visualization of the affected nerve during surgical decompression revealed a consistent pattern of pathological changes (Figure 1). A thickened, unyielding transverse carpal ligament or other compressive structure was observed in 75.5% (n=40) of cases. Adhesions) were found in 18.8% (n=10). Evidence of chronic nerve compression, including a pale, ischemic appearing nerve segment, was present in 81.1% (n=43). Most strikingly, frank nerve swelling proximal to the compression site was documented in 94.3% (n=50) of cases.

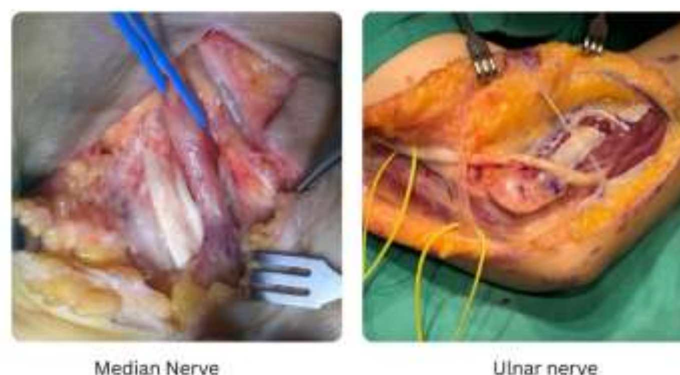

Figure 1: Intra-operative findings

Figure 1 demonstrate the hour glass appearance of the median nerve (left image) and ulnar nerve (right image).

4. Discussion

To the best of our knowledge, this study represents the first epidemiological audit of surgically treated

upper limb compressive neuropathies in Malaysia. Our findings provide a critical, foundational insight into the surgical landscape of these conditions at a major national tertiary referral center and reveal several important patterns that have significant implications for clinical practice, service planning, and future research in the Southeast Asian region.

The most striking finding of this study is the overwhelming dominance of carpal tunnel syndrome, which accounted for 83% of all surgical cases. This is consistent with global literature, where CTS is recognized as the most common entrapment neuropathy, with a reported annual incidence of 1-3 per 1,000 persons in Western populations [4-6]. However, what is particularly concerning in our cohort is the mean symptom duration of 4.0 years prior to surgical intervention. This delay substantially exceeds published data from developed healthcare systems, where the average time from symptom onset to carpal tunnel release is typically less than 12-18 months [7].

The finding that 84.9% of cases were documented as occupationally related is substantially higher than reported in most Western epidemiological studies, where occupational factors typically account for 30-50% of CTS cases [8, 9] . From a public health perspective, this finding underscores the urgent need for workplace-based preventive interventions. Ergonomic assessments, job rotation, provision of wrist-supporting equipment, and worker education programs targeting high-risk industries could potentially reduce the incidence of work-related compressive neuropathies [10]. Additionally, current guidelines for occupational health surveillance in Malaysia may need revision to incorporate earlier screening for CTS and other entrapment neuropathies in at-risk worker populations.

Clinically, our cohort presented with advanced disease, as evidenced by the high preoperative Quick DASH score (69.7 ± 21.0) and the finding that 69.8% of patients already had demonstrable motor deficits on clinical examination. This contrasts favorably with early-stage CTS series where isolated sensory symptoms predominate [11]. The presence of motor weakness at the time of surgery is a poor prognostic indicator, as axonal loss and motor end-plate denervation may be only partially reversible even after successful decompression [7]. This observation reinforces the argument for earlier surgical referral before irreversible motor injury occurs.

All patients in our cohort had abnormal nerve conduction studies, with 100% demonstrating sensory latency prolongation and 84.9% demonstrating motor latency prolongation. The universal abnormality of sensory studies reflects both the sensitivity of sensory nerve fibers to early compression and the high pretest probability of disease in our surgical population [12]. Importantly, however, the absence of patients with normal electrodiagnostic studies but classic clinical CTS, a phenomenon reported in up to 25% of cases in some series [11], suggests potential under-recognition of this subgroup in our center‘s referral pathway.

The intraoperative findings of nerve swelling (94.3%) and pale discoloration (81.1%) are consistent with chronic nerve compression pathophysiology, where venous congestion, endoneurial edema, and local ischemia culminate in visible morphological changes [13]. The high rate of thickened compressive ligaments (75.5%) supports the mechanical etiology of these entrapments and reinforces the rationale for surgical division of these structures.

Study Limitations and Future Directions

Several limitations of this study must be acknowledged. First, the retrospective design relies on the accuracy and completeness of documentation in electronic medical records. Variables such as occupational association and symptom duration were based on clinical documentation rather than standardized

occupational assessments. Second, as a single-center study from a tertiary referral hospital, our findings may not be generalizable to primary care settings, district hospitals, or private healthcare facilities in Malaysia. Third, the sample size of 53 cases, while adequate for descriptive epidemiology, precludes multivariate analysis of risk factors and predictors of surgical outcomes. Fourth, we did not capture postoperative outcomes or patient-reported satisfaction measures, which are essential for evaluating the effectiveness of surgical intervention.

Future research should prioritize the following directions: (1) a prospective, multicenter registry of surgically treated compressive neuropathies across multiple Malaysian hospitals to establish national incidence rates; (2) a comparative study of surgical outcomes between early versus late referral groups to quantify the functional impact of delayed surgery; (3) cost-effectiveness analysis of early surgical decompression versus prolonged conservative management in the Malaysian healthcare context; and (4) validation of screening tools and referral criteria for primary care physicians to facilitate earlier recognition of compressive neuropathies.

Clinical and Policy Implications

Despite these limitations, our findings have immediate practical implications. The prolonged symptom duration and advanced disease at presentation suggest that current referral pathways for suspected compressive neuropathies in Malaysia may be suboptimal. We recommend the development and implementation of a standardized, evidence-based clinical pathway that includes: (1) clear criteria for primary care referral to specialist evaluation; (2) time-bound trials of conservative management (not exceeding 3-6 months) before surgical consideration; (3) avoidance of repeated steroid injections in the absence of sustained benefit; and (4) routine preoperative documentation of Quick DASH scores to establish baseline function and enable outcome measurement.

From a health systems perspective, the high surgical volume of carpal tunnel releases justifies investment in dedicated “nerve entrapment clinics” or streamlined day-surgery pathways to improve efficiency and reduce waiting times. The Malaysian Ministry of Health may consider incorporating surgical volume projections for compressive neuropathies into workforce planning for hand surgery training and operating theatre allocation.

5. Conclusion

This first epidemiological audit of upper limb compressive neuropathies in Malaysia reveals a surgical landscape dominated by carpal tunnel syndrome, with a striking female preponderance, high rates of occupational association, and evidence of significantly delayed presentation with advanced disease. The prevalence of diabetes and other comorbidities exceeds population baseline rates, underscoring the importance of risk factor modification. These findings establish a foundational dataset for service planning, highlight the urgent need for standardized care pathways, and provide a benchmark against which future interventions and outcomes can be measured. As Malaysia continues to develop its hand surgery services, prospective, multicenter studies are urgently needed to capture the full burden of these disabling but treatable conditions and to optimize patient outcomes through earlier diagnosis and timely surgical intervention.

6. References

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