Brain and Spine 2 (2022) 100887

Contents lists available at ScienceDirect

Brain and Spine

journal homepage: www.journals.elsevier.com/brain-and-spine

Controversies in treatment strategies in patients with foot drop due to peroneal nerve entrapment: Results of a survey among specialists

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ARTICLE INFO

Keywords:
Peroneal neuropathies
Surveys and questionnaires
Patient care management

ABSTRACT

Introduction: Peroneal nerve entrapment is a frequent cause of foot drop. Despite being frequent, no guidelines exist to recommend surgical or non-invasive treatment, leading to important variations in daily practice.
Research question: To map variation in daily practice.
Materials and methods: An online Qualtrics survey was distributed among neurosurgeons, neurologists, orthopaedic surgeons and physical medicine and rehabilitation physicians through various national and international scientific organizations, mapping current treatment strategies. Descriptive statistics and non-parametric tests were used to analyse data with SPSS.
Results: Responses from 181 out of 221 participants from 35 countries were analysed. A large majority of participants agreed that good evidence supporting any treatment strategy is lacking (77.9%) and that daily practice is mostly guided by own beliefs and experience (84.0%). Both non-invasive treatment and neurolysis are well established treatment strategies (supported by respectively 92.3% and 93.4% of physicians). Timing of neurolysis and duration of non-invasive treatment varied considerably. Duration of non-invasive treatment was significantly shorter in the group of surgeons compared to non-surgeons ($p = 0.033$). Most physicians consider neurolysis a valid treatment option. However, significant more non-surgeons than surgeons were opposed to surgical treatment ($p = 0.001$).
Discussion and conclusion: Important differences in attitudes were observed not only between, but also within specialisms, regardless of physician experience. This survey highlights important variations in daily practice for foot drop due to peroneal entrapment and emphasizes the need for future controlled studies.

1. Introduction

1.1. Background

Peroneal neuropathy is the most frequent mononeuropathy in the lower limb (Poage et al.; Broekx and Weyns) and often associated with foot drop causing gait difficulties and an increased risk of falling (Stewart). Prevalence of symptomatic peroneal neuropathy ranges from 19 to 40 per 100.000 inhabitants in Egyptian studies (Kandil et al., 2012; Khedr et al., 2016), but epidemiologic data remains limited.

The nerve can easily be compressed at the level of the fibular head, due to its superficial course through the fibular tunnel (Gloobe and Chain, 1973; Ryan et al.). Compression can result from cysts and tumours (Weyns et al., 2012), bracing and tight casts. Other established risk

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https://doi.org/10.1016/j.bas.2022.100887
Received 31 January 2022; Received in revised form 13 March 2022; Accepted 29 March 2022
Available online 9 April 2022

factors are habitual leg crossing, squatting and kneeling (Marciniak, 2013), (excessive) weight loss (e.g. after bariatric surgery (Broekx and Weyns, 2018; Elias et al., 2006; Sen et al., 2020; Weyns et al., 2007; Meylaerts et al., 2011)), metabolic disorders (e.g. diabetes mellitus, hypothyroidism (Farhad et al., 2016)) and being long-term bedridden (Poage et al., 2016; Aprile et al., 2005; Bowley and Doughty, 2019). Furthermore, peroneal nerve damage can be iatrogenic or posttraumatic (Bowley and Doughty, 2019; Aprile et al., 2000).

Peroneal neuropathies can be idiopathic, idiopathic with established risk factors (e.g. leg crossing, weight loss) and non-idiopathic (e.g. trauma, iatrogenic, cysts and tumours) (Oosterbos et al., 2021). The term peroneal nerve entrapment is used to refer to idiopathic peroneal neuropathies with and without established risk factors (Oosterbos et al., 2021). This survey focuses on management strategies in patients with foot drop due to peroneal nerve entrapment; non-idiopathic peroneal neuropathies were therefore not taken into account.

Treatment strategies in reported case series range from early surgical intervention to prolonged non-invasive treatment (Oosterbos et al., 2021) and no guidelines exist on the treatment of patients with foot drop due to peroneal nerve entrapment (Oosterbos et al., 2021). Available evidence to support either surgical intervention or non-invasive treatment is limited and mostly of low quality (Oosterbos et al., 2021).

1.2. Purpose/aim

The purpose of the survey is to map variation in daily practice and to observe differences between the medical specialties involved, in the absence of high quality evidence to guide treatment. The survey aims to be an incentive for future studies by causing awareness about the differences in therapeutic approaches to the same pathology. Since peroneal nerve entrapment is the third most frequent mononeuropathy and a frequent cause of foot drop causing gait difficulties, establishing standard of care and treatment algorithms is of importance.

2. Methods

2.1. Study design and data collection methods

We designed a cross-sectional survey on daily management strategies in peroneal nerve entrapment. The survey was reported according to the Consensus-Based Checklist for Reporting of Survey Studies (CROSS) when applicable (Sharma et al., 2021). The survey consisted of 20 questions over 2 sections: a statement-based part and a case-based part. There were 19 multiple-choice questions and 1 open question. The final questionnaire is available in appendix 1. Statements and cases were created by a multidisciplinary team of neurosurgeons, neurologists and physical medicine and rehabilitation physicians. The pilot survey ran one time within the department of neurosurgery of the University Hospitals Leuven.

2.2. Sample characteristics

The survey targeted both experienced and inexperienced neurologists, neurosurgeons, orthopaedic surgeons and physical medicine and rehabilitation physicians to be able to reflect daily practice worldwide. Experience was defined in function of caseload per year (<5 per year, 5–15 per year, > 15 per year), in terms of subjective experience (no experience, some experience, extensive experience) and in function of physician's position (resident, specialist <10 years, specialist >10 year). This study population was targeted since these medical specialties are heavily involved in daily care of patients with peroneal nerve entrapment.

2.3. Survey administration

We designed a web-based survey using Qualtrics software. The survey was distributed from October 29th, 2020 until June 7th, 2021 through the following (inter)national scientific communities:

- Belgian Society of Neurosurgery (BSN)
- Belgian Neurological Society (BVN-SBN)
- Royal Belgian Society of Physical and Rehabilitation Medicine (RBSPMR)
- International Society of Physical and Rehabilitation Medicine (ISPRM)
- European Academy of Neurology (EAN), panel of neuropathy experts
- World Federation of Neurosurgical Societies (WFNS), peripheral nerve section
- European Association of Neurosurgical Societies (EANS), overall distribution and separate distribution to the peripheral nerve section
- Serbian Neurosurgical Society (SNSS)
- Royal Belgian Society of Orthopaedic Surgery and Traumatology (SORBCOT)

Participants were specifically asked to only complete the survey once in the introduction to prevent multiple participation.

2.4. Ethical considerations

Study approval was obtained by the institutional review board of the University Hospitals Leuven, Belgium (study number S64808). Informed consent of all participants was obtained. Data was anonymously collected. A password to gain access to the survey was used to prevent unauthorised survey access.

2.5. Statistical analysis

Responses were considered incomplete and not suited for analysis if less than 80% of all questions were answered. Answers to the statement-based part were considered more informative (and thus more important) than answers to the case-based part. Statistical analysis was performed using IBM SPSS Statistics Version 25. Descriptive statistics including frequencies, bar and pie charts and cross tabulations were used to discuss survey results. Non-parametric tests, the Pearson Chi-Square and Fisher's Exact Test (when appropriate), were used to assess correlations and (in) dependency of ordered and non-ordered nominal variables (significance level $\alpha = 0.05$). Cramer's V was used as a measure of effect size.

3. Results

3.1. Respondent characteristics

Two hundred twenty-one physicians participated in the survey. Responses from 181 physicians were analysed after removal of 40 incomplete responses. The survey was fully answered by 167 physicians. Thirteen surveys lacked answers to the case-based part. One survey lacked information on the use of an orthosis and electrostimulation and another one lacked information on the physician's discipline.

In total 97 neurosurgeons (53.9%), 40 neurologists (22.2%), 3 orthopaedic surgeons (1.6%) and 40 physical medicine and rehabilitation physicians (22.2%) completed the survey in a meaningful way, representing 35 different countries worldwide (appendix 2). Almost half (49.2%) of physicians practiced in Belgium. Both inexperienced and experienced physicians participated in the survey. Caseload was limited to less than 5 cases per year in 38.1% of physicians and to 5 to 15 cases per year in an equal percentage. A minority (23.8%) of participants treated more than 15 cases per year. Only 15 physicians stated to have no experience in treating patients with foot drop due to peroneal nerve entrapment (8.3%), whereas 44 physicians had subjective extensive experience with the pathology (24.3%). Among the subjects were 30 residents (16,6%), 47 physicians with less than 10 years of experience (26.0%) and 104 physicians with more than 10 years of experience (57.5%).

3.1.1. Main findings

3.1.1.1. Role of imaging. The use of imaging modalities varies considerably among physicians. Ultrasound is the most frequently used modality, but up to 20% of physicians do not perform imaging at all (Fig. 1).

3.1.2. Evidence and daily practice

Overall, 78% of physicians agreed (either 'strongly' or 'somewhat'), that current literature is lacking evidence to guide treatment and that further research (randomized controlled trial) is warranted (Fig. 2). 13% did not agree with this statement. Most physicians (84%) stated that daily practice is habitually based on expert opinion, own experience and beliefs. Only 3% of physicians did not support this statement (Fig. 2).

This conformity is independent of discipline (p_A* = 0.077, p_B** = 0.286) and experience. Experience is expressed as caseload per year (p_A* = 0.764, p_B** = 0.427), years of practice (p_{A*} = 0.133, p_B** = 0.140) or subjective treatment experience (p_{A*} = 0.471, p_B** = 0.191). Table 1 summarizes data. High percentages of physicians with no experience (66.7%) or low caseload (79.7%) and residents (96.7%) believe that daily practice is mostly guided by own beliefs and experience. At the other end of the spectrum, up to 88.6% of physicians with extensive experience and up to 90.7% of physicians with a caseload higher than 15 cases per year agree that evidence is lacking to guide treatment and that daily practice is mostly guided by own beliefs, experience and expert opinion. These ideas are shared by a large majority of neurosurgeons, neurologists and rehabilitation physicians. Table 1 shows that a large majority of physicians worldwide (Belgian participants not taken into consideration) support both statements.

3.1.3. Foot drop management

For most specialists neurolysis is considered a valid treatment option for patients with persistent foot drop. Only 7% believe that there is no place for neurolysis in peroneal nerve entrapment. Significantly more 'non-surgeons' were opposed to neurolysis compared to surgeons (p = 0.001, Cramer's V = 0.254). Although about 90% of physicians would operate within 6 months after symptom onset, no consensus exists on the optimal timing of surgery. One in 5 prefers surgery as soon as possible after diagnosis. Other physicians opt for initial non-invasive treatment followed by neurolysis if foot drop persists after 6 weeks (34.8%) or after 6 weeks to 6 months (31.5%). Almost all neurosurgeons (99%) considered neurolysis as a valid treatment option. Fig. 3 summarizes the responses regarding optimal timing of surgery. Based on the brief cases, less than 10% of physicians would suggest operative decompression as the first treatment strategy within 1 week after symptom onset. Up to one third would perform a decompression if a patients presents 6 weeks after onset of foot drop and another thirds after 3 months. Forty-five percent still considers neurolysis a valid treatment option after one year. The responses to the brief cases are available in appendix 3.

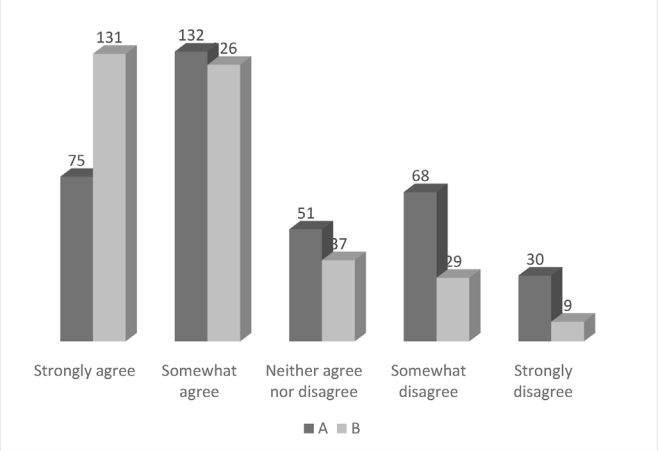

Fig. 2. – Evidence and daily practice. A *"Based on current evidence, the optimal treatment of peroneal nerve entrapment is not known. There is a need for a randomized controlled trial comparing surgery to conservative treatment."* **B** *"Management of peroneal nerve entrapment in my daily practice is mostly based on expert opinion and my own experience and beliefs".*

Opinions were divided on the length and intensity of non-invasive treatment. Duration of non-invasive treatment was significantly shorter in the group of surgeons versus the group of 'non-surgeons', with 83% of surgeons treating up to six months in a non-surgical manner versus 69% of 'non-surgeons' (p = 0.033, Cramer's V = 0.167). Most physicians would prescribe between 10 and 60 sessions of physiotherapy, and only 8% of physicians, half of which were neurosurgeons, do not prescribe physiotherapy. Fig. 4 illustrates the attitudes towards non-invasive treatment.

The impact of mobility and age on treatment decision cannot be clearly established based on survey results (Fig. 5).

3.1.4. Use of foot-ankle orthosis and electrostimulation

The large majority of physicians prescribe a foot-ankle orthosis (FAO) in the treatment of foot drop due to peroneal nerve entrapment, with only 5% not favoring the use of an orthosis. Most physicians (40%) prescribe a FAO within six weeks after foot drop onset. A little more than 10% prescribe a FAO after more than 6 months. Attitudes towards the use of FAO differed between disciplines. Nearly all (97.5%) neurologists and physical medicine rehabilitation physicians (97.5%) are in favor of the use of a FAO, whereas 8% of the neurosurgeons are not in favor of

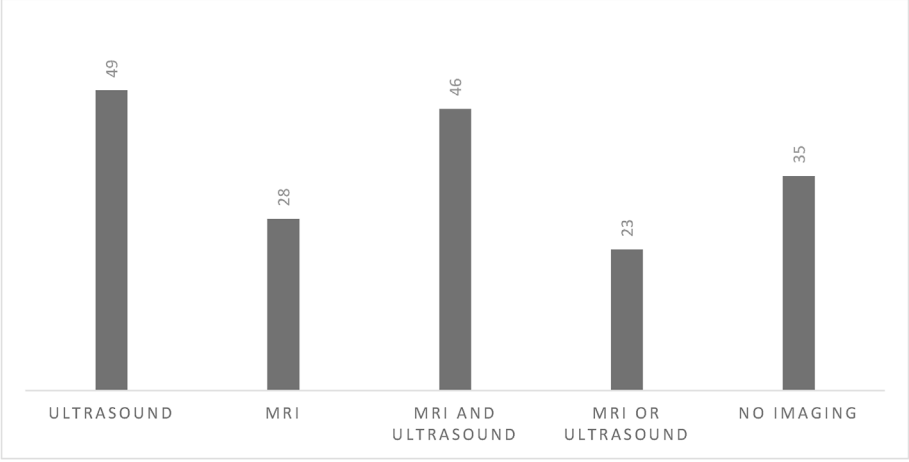

Fig. 1. – Imaging *"In peroneal nerve entrapment, my preferred imaging modality consists of:"*

Table 1
Cross tabulations projecting the percentage of physicians that agree (either 'strongly or 'somewhat ') to two survey statements according to treatment experience, years of practice, caseload per year, discipline and geography.

		"Best treatment is not known based on current literature. There is a need for a RCT"	"Daily practice is mostly guided by own beliefs, experience and expert opinion"
Reported treatment experience	No experience (Farhad et al., 2016)	86.7%	66.7%
	Some experience (122)	81.9%	84.5%
	Extensive experience (44)	63.6%	88.6%
Years of practice	Resident (Williams and Trzil, 1991)	96.7%	96.7%
	Specialist <10 years (47)	80.8%	76.6%
	Specialist >10 years (104)	71.2%	83.6%
Caseload per year	<5 (69)	81.2%	79.7%
	5–15 (69)	75.3%	84.0%
	>15 (43)	76.7%	90.7%
Discipline	Neurosurgery (97)	77.4%	89.7%
	Neurology (40)	80.0%	80.0%
	Physical medicine and rehabilitation (40)	77.5%	75.0%
	Orthopaedic surgery (Stewart)	66.7%	66.7%
National vs international	Belgium (89)	83.1%	86.5%
	Rest of the world (92)	72.8%	81.5%

* p-value regarding statement: "Based on current evidence, the optimal treatment of peroneal nerve entrapment is not known. There is a need for a randomized controlled trial comparing surgery to conservative treatment."
** p-value regarding statement: "Management of peroneal nerve entrapment in my daily practice is mostly based on expert opinion and my own experience and beliefs".

prescribing a FAO. This small trend however, is not statistical significant ($p = 0.189$). The results on FAO timing are summarized in Fig. 6.

Most physicians use electrostimulation in the treatment of patients with foot drop due to peroneal nerve entrapment (83.4%), either always (37%), in selected cases (20.4%) or depending of the treating physiotherapist (26%). Neurologist were significantly less inclined to use electrostimulation ($p = 0.001$, Cramer's $V = 0.263$).

3.1.5. Recovery of foot drop

Opinions were divided on the most important outcome measure of patients with foot drop. Clinical assessment of ankle dorsiflexion strength using the MRC-score is acknowledged as the most important outcome measure by 32%, whereas 36% focus mainly on gait improvement. Patient-reported outcome measures are prioritized by 20%, and 10% consider electrophysiological evolution to represent the most important outcome measure (Fig. 7).

4. Discussion

4.1. Interpretation

This international survey studied daily management strategies in patients with foot drop due to peroneal nerve entrapment based on the responses from 181 physicians across 35 countries worldwide. Physicians playing an important role in the treatment of these patients i.e. neurologists, neurosurgeons and physical medicine and rehabilitation physicians were well represented in the survey, and the multidisciplinary dimension of patient treatment was acknowledged.

A conclusion that could be drawn was that most physicians were aware of the lack of good evidence supporting any treatment strategy and the role of experience, expert opinion and own beliefs in managing daily practice. This conclusion was independent of physician experience and discipline.

Both neurolysis and non-invasive treatment were considered valid treatment options for most physicians, while only a minority not supported either surgery or physiotherapy. Almost 90% of survey participants would suggest neurolysis within 6 months after foot drop onset, with a large variation in timing of surgery. This variation was present within all specialisms. Physiotherapy and the prescription of a FAO were considered as standard of care for the large majority of physicians based on the finding in this survey. Differences in attitudes between surgeons and 'non-surgeons' were observed. Significant more 'non-surgeons' did not support surgical treatment ($p = 0.001$). Furthermore, duration of non-invasive treatment was significantly shorter (up to 6 months) in the group of surgeons compared to 'non-surgeons' ($p = 0.033$).

Good outcome in this patient group could not be uniformly defined, possibly leading to variation in outcome reporting. One in 3 of

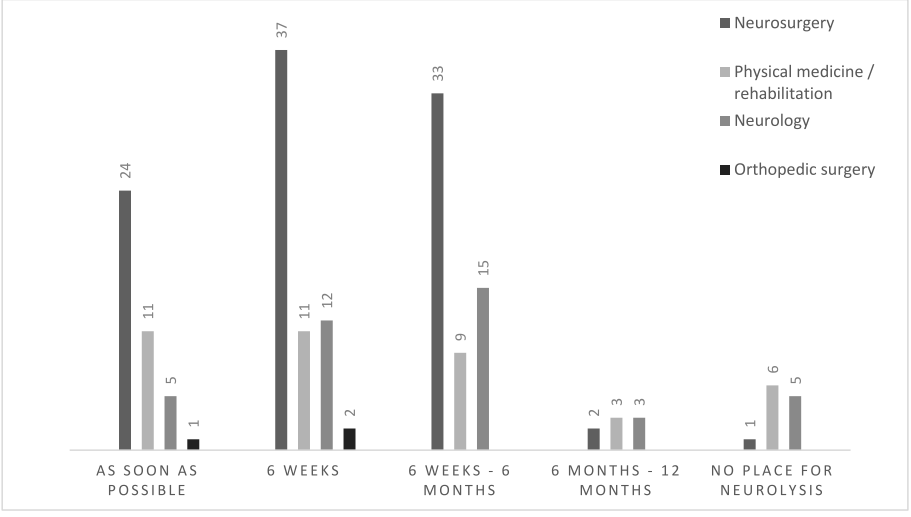

Fig. 3. Timing of neurolysis per specialism. *"Optimal timing for operative decompression of peroneal nerve entrapment at the fibular head in patients with an associated foot drop (MRC-grade ≤ 3) is" (neurolysis was only indicated in case of persisting (= MRC for ankle dorsiflexion ≤ 3).*

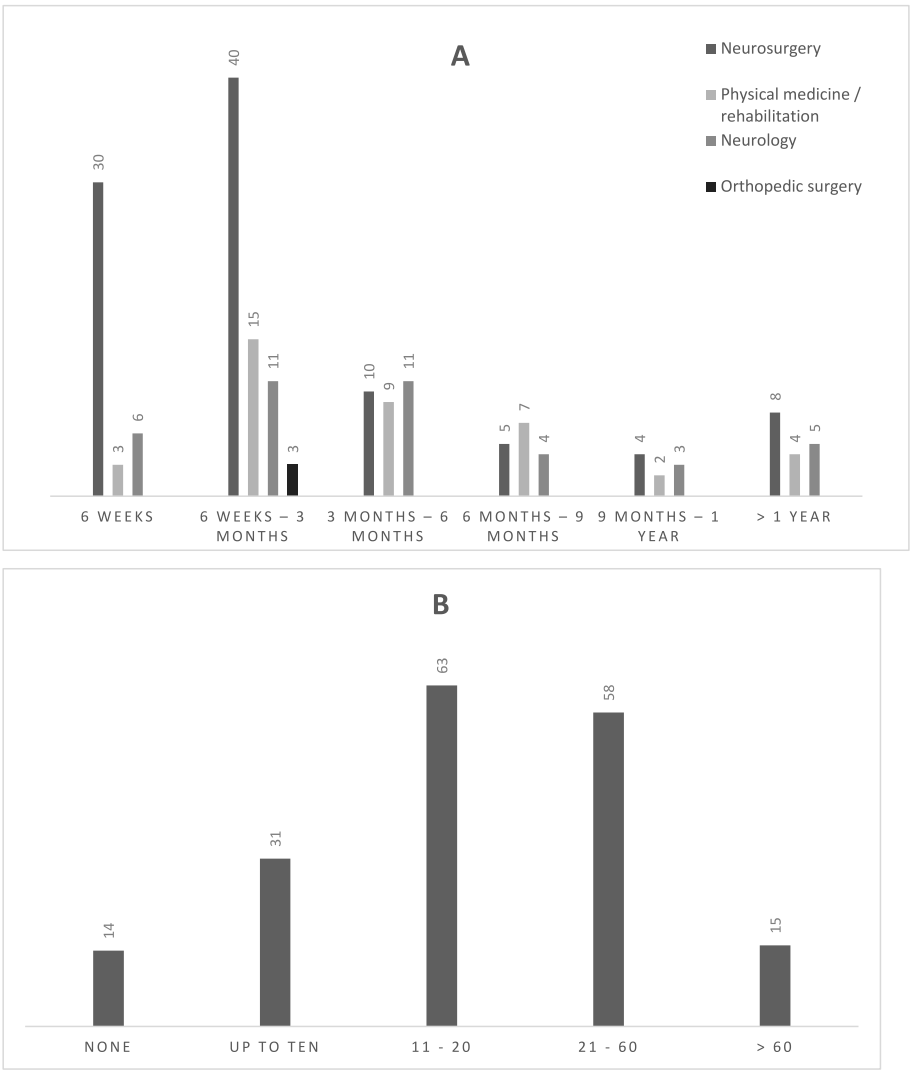

Fig. 4. Attitudes towards non-invasive treatment. ***A*** *Duration of non-surgical treatment in peroneal entrapment* per *specialism and* ***B*** *overall number of physiotherapy sessions.*

participants chose functional patient outcome, i.e. gait improvement, as the most important outcome measure. An almost equally large group considered improvement of MRC-score the most important outcome measure, although patients with the same MRC score can experience different degrees of gait problems. One remark is that the survey only probed for the most important outcome measure, which does not imply that other outcome parameters were not considered in daily clinical practice.

Almost 1 out of 5 participants did not perform imaging, despite the high diagnostic performance of both MRI and ultrasound (Oosterbos et al., 2021). The survey however focused on management strategies and a deeper analysis of differences in diagnosing patients with peroneal nerve entrapment is beyond the scope of this manuscript. It would be interesting for future surveys to zoom in on differences in diagnostics (for example the variable definition of a conduction block in motor nerve conduction studies (Oosterbos et al., 2021)) since these differences could lead to different groups of patients.

In general, this survey aided in highlighting major differences in management strategies for peroneal entrapment and confirmed major differences in daily practice between and within specialties. This divergence most likely results from a lack of high quality clinical studies (Oosterbos et al., 2021). In the absence of high quality evidence, treatment divergence can be expected. However, these results should raise awareness about other standard treatment approaches that are maybe opposed to his of hers own beliefs. Controlled trails are required to establish the role of surgery and non-invasive treatment strategies in patients with footdrop due to peroneal nerve entrapment.

The observed differences in treatment strategies for patients with peroneal nerve entrapment are more outspoken compared with other frequent encountered entrapment mononeuropathies. Carpal and cubital tunnel syndrome are the most frequent encountered mononeuropathies and are well studied, resulting in clear management strategies (Padua et al., 2016; Assmus et al., 2011; Bartels et al., 2005; Staples and Calfee, 2017; Nakashian et al., 2020). A Cochrane review on meralgia paresthetica (Khalil et al., 2012) in 2012, could only identify weak evidence to support either invasive or non-invasive treatment of patients with entrapment of the lateral cutaneous nerve of the thigh. The authors concluded that, based on their findings, randomized controlled trials are warranted. However, most authors seem to agree on a step-up treatment policy, only suggesting surgery for refractory cases (Grossman et al., 2001; Williams and Trzil, 1991; Sanjaya, 2020; Nouraei et al., 2007). A similar survey for meralgia paresthetica was not identified.

4.2. Limitations

Several weaknesses can be identified and need to be taken into

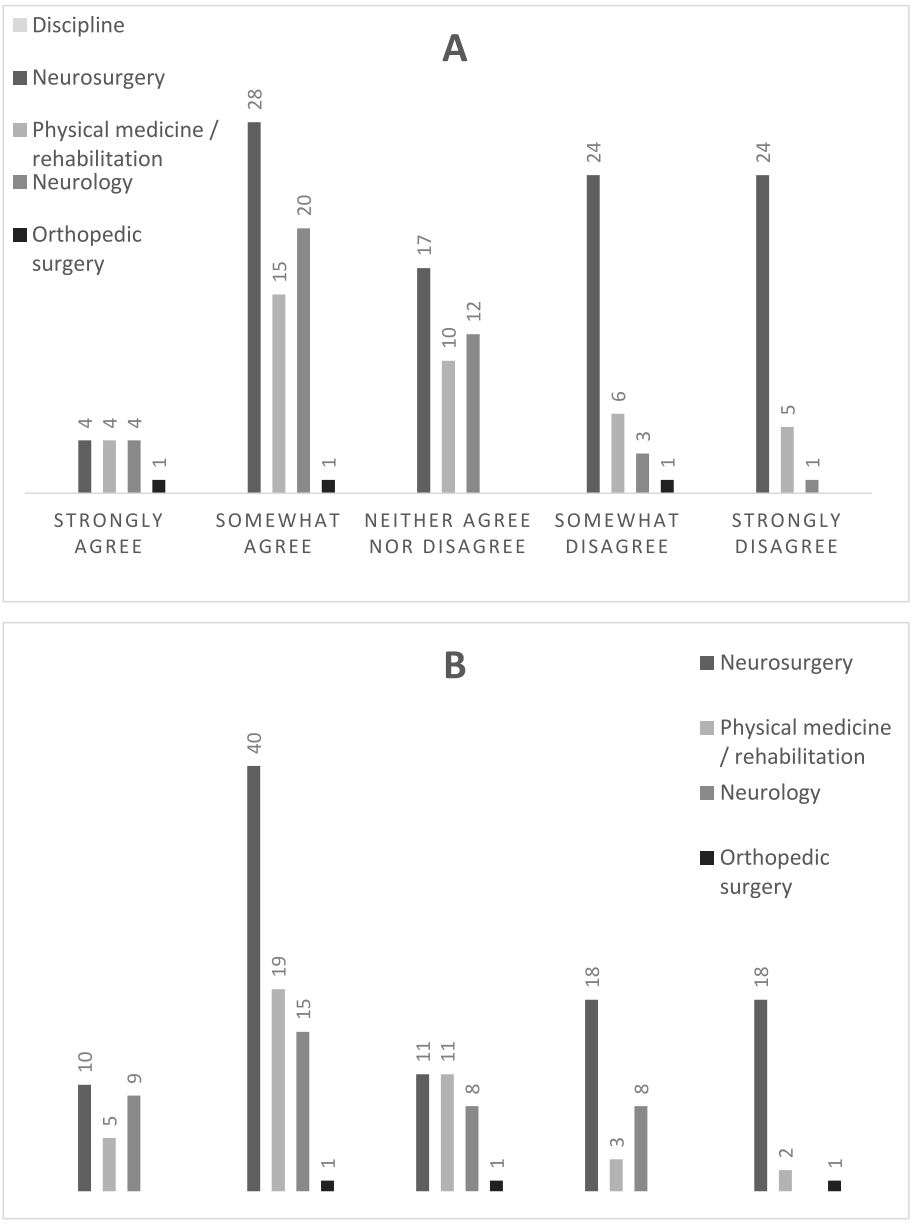

Fig. 5. Impact of age (A) and mobility (B) on treatment decision per specialism.

consideration when interpreting survey results. Despite being distributed within major international scientific organizations, the overall number of participants is rather low. Furthermore, participation bias can influence the results since more neurosurgeons (53.9%) than neurologists (22.2%) and physical medicine and rehabilitation physicians (22.2%) were involved. Almost half of physicians (49.2%) practiced in Belgium. This can accentuate treatment variation in Belgium more than in the rest of the world. However, the same results were observed amongst physicians of 34 other nationalities, leaving out Belgian responders (see Table 1). The available data was too limited to further compare attitudes between different nations worldwide in a meaningful way. Only multiple choice questions where included in the survey, possibly excluding other attitudes towards treatment strategies from consideration.

4.3. Generalizability

The questionnaire has not been validated. Therefore, variations in responses do not necessary reflect variation in treatment strategies. A neglectable amount of orthopaedic surgeons and no plastic and reconstructive surgeons were involved in the survey, which could influence the generalization of survey results.

5. Conclusion

Survey results confirm that treatment strategies in patients with foot drop due to peroneal nerve entrapment differ substantially. Management ranged from early surgical intervention to prolonged conservative treatment. Differences were observed not only between, but also within involved medical specialties. Survey results raise awareness about opposing opinions in the professional community warranting controlled trials to establish the role of surgery and non-invasive treatment in this patient population.

Funding

No funding was received for this research.

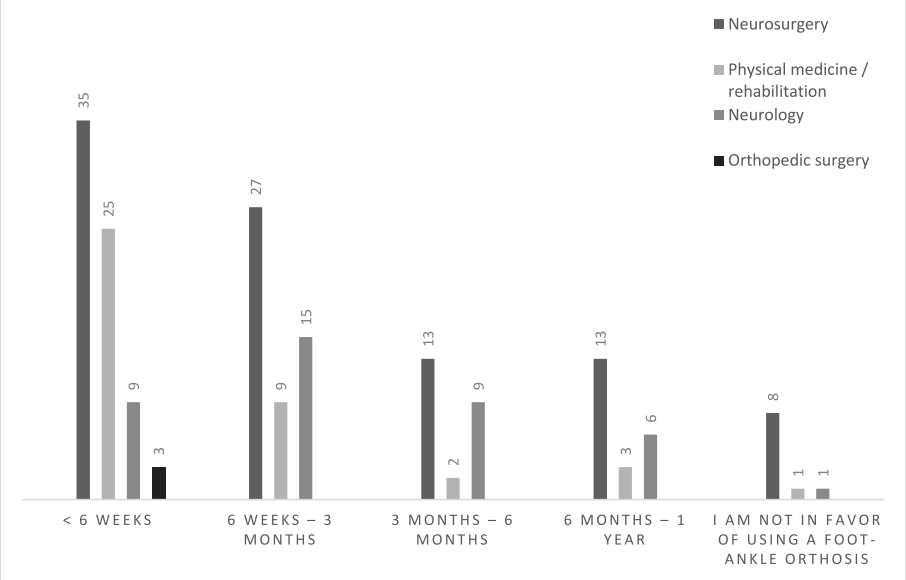

Fig. 6. Timing of foot ankle orthosis per specialism.

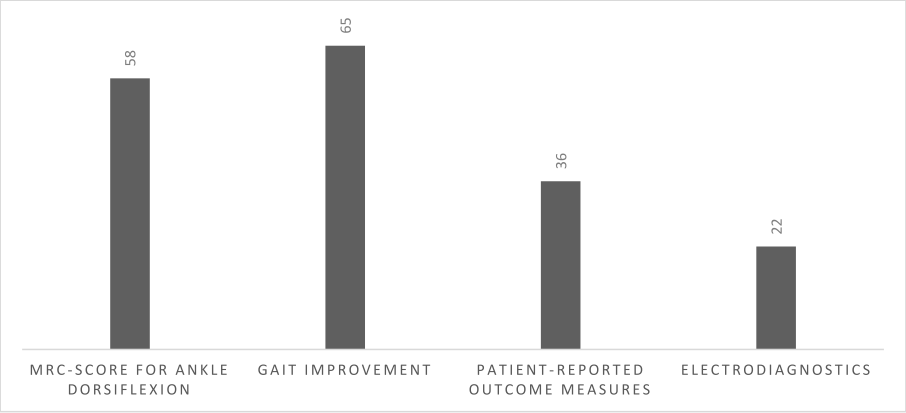

Fig. 7. Outcome measure "*The most important outcome parameter in the recovery of patients with a foot drop due to peroneal nerve entrapment is.***"**

Declaration of competing interest

There is no potential conflict of interest to declare.

Acknowledgements

The authors acknowledge the Belgian Health Care Knowledge Centre (KCE) for their support.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.bas.2022.100887.

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