



# Prognostic indicators of surgical outcome in painful foot drop: a systematic review and meta-analysis

Fozia Saeed<sup>1</sup> · Soumya Mukherjee<sup>1</sup> · Kausik Chaudhuri<sup>2</sup> · Joel Kerry<sup>1</sup> · Sashin Ahuja<sup>3</sup> · Debasish Pal<sup>1</sup>

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## Abstract

**Purpose** Foot drop is a relatively uncommon presentation of lumbar degenerative disease and there is currently a paucity of evidence on management and outcomes which is reflective of the lack of standardised treatment provided to patients. The purpose of this systematic review and meta-analysis is to determine the effectiveness of surgical management and the factors that predict surgical outcome.

**Methods** A systematic database search of Cochrane Library, Ovid Medline, Pubmed, Embase and Google Scholar was undertaken from inception through August 2018. Only studies reporting on surgical outcome in adult patients who had a painful foot drop and underwent decompression were included. Case reports and studies with surgical fixation were excluded. Study quality was assessed using the Newcastle–Ottawa Scale. Data were pooled using a random-effects model.

**Results** 797 studies were screened and 9 observational studies met the inclusion criteria. This resulted in a total of 431 patients who underwent decompression for foot drop. Pooled rates of outcome for improvement in foot drop MRC grade were 84.5% (range 67.9–96%). Sub-group meta-analyses of studies revealed a statistically significant association between duration of foot drop (pooled 4.95 [95% CI 1.13–21.74]), severity of preoperative weakness (pooled 0.38 [95% CI 0.15–0.93]) on post-operative outcome and age (pooled 6.28 [1.33–29.72]).

**Conclusion** This is the first systematic review and meta-analysis to explore the outcome and prognostic indicators of lumbar decompression for foot drop. Findings indicate that age, duration of foot drop weakness and MRC grade of foot drop prior to intervention were strong predictors of surgical outcome.

**Keywords** Foot drop · Spinal surgery · Lumbar degenerative disease · Systematic review · Meta-analysis · Surgical decompression

## Background

Foot drop is characterised by weakness of the tibialis anterior muscle (the principal dorsiflexor of the foot) and the nature of the underlying aetiology can be divided into three broad categories which include neurological, muscular or anatomical [1–6]. It is a relatively uncommon presentation of lumbar degenerative disease (LDD) and is secondary to nerve root compression as a result of disc herniation, facet

joint cysts, hypertrophy of the ligaments, osteophytes or, more often, a combination of the above [1, 7–10]. The tibialis anterior muscle receives majority of its supply from the L5 nerve root however, as literature has demonstrated, the L4 and S1 nerve roots can also contribute to this supply [11, 12]. Nonetheless, the impact of this condition on the affected person can be life-long and debilitating. The prevalence and incidence rates of foot drop from lumbosacral radiculopathy may well be underestimated and are approximated between 0.6 and 7% [1, 6, 13–15].

The existing literature is limited with no randomised controlled trials published on this condition. As a result, there is no consensus on the management of foot drop and controversy exists whether operative management confers any beneficial outcome [16]. Some studies have demonstrated that the natural history of radicular weakness improves with time when managed non-operatively. In 1970, Hakelius reported

✉ Fozia Saeed  
fozia.saeed1@nhs.net

<sup>1</sup> Department of Neurosurgery, Leeds General Infirmary, Great George Street, Leeds LS1 3EX, UK

<sup>2</sup> University of Leeds, Leeds, UK

<sup>3</sup> University Hospital of Wales, Cardiff, UK

paresis being observed in a greater number of patients post-operatively than those managed conservatively [17]. Subsequent studies have also reproduced similar results suggesting up to 75% of patients recover motor weakness by 6 months without any intervention [18–20]. However, many of these studies are outdated and surgical practice has since advanced. Weber et al. 1970 [19], managed their cohort of patients conservatively with analgesia as they believed this would alter the measurements of muscle function. A major drawback of this study is that majority of their patients had mild weakness which could be attributed to radicular pain. Dubourg et al. 2002 [20], found no statistical differences between conservatively managed (32%) versus operatively managed (25%) patients. Though, this can be explained by the confounding issue of including severe weakness only in the surgically managed group.

Contrary, studies have also demonstrated improved outcomes following surgical decompression of nerve roots. Aono et al. 2007 [1], found that 61% of their cohort, treated operatively for foot drop (MRC grade < 3), had improved at mean follow up of 3.7 years. Postacchini et al. 2002 [21], reported a greater improvement in 96% of patients undergoing surgical management, but at a lengthier mean follow up of 6.7 years. Other authors have also concluded similar outcomes with an improvement in motor weakness of up to 93% in patients [2, 8, 11, 13, 20, 22–28]. The differences in patient population, inclusion criteria and outcome measures are attributable to the discrepancies in reported rates of recovery.

Current published literature provides no clear guidance on when surgical intervention should be offered and which patients are most suitable for surgical management. It is therefore, imperative to establish this in order to avoid unnecessary harm to patients and optimise management of foot drop due to LDD.

Authors that have addressed this issue provide some evidence to suggest various factors, such as age, duration and severity of foot drop and underlying pathology may predict outcome [24, 28–33].

Tenaka et al. 2017 [34], demonstrated a negative clinical impact of long paresis duration (> 30 days) and significant preoperative weakness on surgical outcome. In contrast, Aono et al. 2014 [35], reported on no associations between factors such as age, preoperative weakness, gender and history of leg pain. The discrepancy of findings in studies has indeed resulted in the hugely variable practice observed in many countries. The current main indication for surgical management, agreed by most though, is the presence of pain along with paresis [2, 7, 36].

To determine the efficacy of surgical management of foot drop and to improve the quality of patient care, we have undertaken a systematic review and meta-analysis of the current published data.

## Objectives

The primary objective of this systematic review and meta-analysis is to clarify the evidence base available surrounding painful foot drop secondary to LDD and determine the efficacy of surgical management. Secondary objectives include identifying factors that would influence the recovery of motor weakness.

## Methods

We conducted a systematic search of the scientific literature surrounding painful foot drop and performed a meta-analysis of the pooled data from the eligible studies. We adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) and Meta-Analysis of Observational Studies in Epidemiology (MOOSE) guidelines [37, 38]. PROSPERO registration CRD42018098816.

## Study selection and inclusion criteria

The Population, Intervention, Criteria, Outcome and Study design (PICOS) framework was used to specify eligibility criteria (Fig. 1). The diagnosis of foot drop was determined by the Medical Research Council (MRC) power grade of foot dorsiflexion (Fig. 2) and was defined as Manual Muscle Testing (MMT) score ≤ 3 [39]. An article qualified for inclusion if the authors had explicitly defined or described the diagnosis of foot drop. The intervention was lumbar decompression surgery. The primary outcome was measured as the extent of recovery of motor weakness in foot dorsiflexion using the MRC power grading scale.

There were no restrictions placed on geographical location and time. Studies were excluded if the article was not easily translatable, case reports (due to high potential for bias), there was no reporting of original data (for example reviews), painless foot drop and if the outcome was not measured using the MRC grading system. We also excluded patients who presented with foot drop as part of cauda equina syndrome (CES), recurrent disc and articles that reported on outcomes following spinal fusion surgery. The rationale for excluding the latter group of patients undergoing fixation was due to this surgical treatment not generally being the standard surgical option for lumbar spinal stenosis or lumbar disc herniation.

## Search strategy

We performed a comprehensive search across the following databases: Cochrane Library, Ovid Medline, Pubmed,

**Fig. 1** Summary of the inclusion and exclusion criteria

Inclusion criteria
Aged > 18 years old
Diagnosis of lumbar degenerative disease
Painful foot drop (unilateral or bilateral)
Clear definition of foot drop
Surgical lumbar decompression and/or discectomy
Outcome measuring tibialis anterior muscle strength
Exclusion criteria
Fusion surgery
Not in English Language
Painless foot drop

**Fig. 2** Manual muscle testing of ankle dorsiflexion based on examination of anterior tibialis according to the modified medical research council scale of muscle strength

0	No contraction of tibialis anterior
1	Flicker of contraction, but no movement of the ankle joint
2	Dorsiflexion of the foot with the effect of gravity eliminated
3	Dorsiflexion of the foot against gravity but no added resistance
4	Dorsiflexion of the foot against gravity and moderate resistance
5	Dorsiflexion of the foot against gravity and full resistance

Embase and Google Scholar. The last search date was August 2018. We consulted with a health research librarian to help develop search terms in order to encompass a wide breadth of studies. No search filters were applied. Supplementary file 1 demonstrates the key search terms utilised and provides an example of a search string used to identify studies for inclusion. We further scrutinised the references within the articles obtained in our search strategy to identify additional relevant articles.

## Data extraction

Two authors (FS and SM) independently screened all article abstracts for inclusion. When an article was deemed to fulfil the inclusion criteria, the full text was obtained. The full text articles were further reviewed independently by two authors (FS and SM) and reasons were recorded for exclusion of any articles. The senior investigator (DP) was consulted to resolve any disagreements. We only included articles with original data. The reviewers also examined the articles for any potential factors that were determined to effect the outcome (Table 1).

**Table 1** Risk factors reported to have an association to outcome for foot drop following operative management within the literature

Risk factor	References
Age	[1, 8, 10, 20, 21, 23, 24, 27, 28]
BMI	[27, 28]
Gender	[1, 10, 20, 23, 27, 29]
Co-morbidities	[8, 10, 21, 22]
Smoking status	[27]
Diagnosis	[1, 8, 10, 21, 23, 29, 32]
Radiological features	[1, 20, 21, 24, 28, 29]
Preoperative muscle strength	[1, 10, 11, 13, 21, 23, 24, 27, 29]
Duration of weakness	[1, 8, 13, 21, 23, 24, 27, 28, 32, 49]
Painful weakness	[1, 22, 24]

## Data synthesis and statistical analysis

A favourable outcome was described as an improvement in the muscle strength of ankle dorsiflexion. This was defined as at least 1 grade of increase on the MRC grading scale. An unfavourable outcome was defined as no change or worsening

in foot dorsiflexion weakness as per the MRC grading scale. We collected data on post-operative symptom severity and duration, follow-up and factors that would predict prognosis with surgical intervention. We calculated the pooled rates of outcome for improvement in foot drop muscle strength with an associated range.

For the meta-analysis, pooled odd ratios (ORs) were generated to determine the pooled effect size of each variable considered. To determine heterogeneity across the studies, we used  $I^2$  Higgins (0–100%). The random effects model was applied when  $I^2$  tests for heterogeneity were moderate to high ( $> 25\%$ ). When heterogeneity was low ( $< 25\%$ ), fixed effects modelling was applied [40]. The  $p$ -value for statistical significance was set at  $\leq 0.05$ . Data analysis and Forest plot were generated using Review Manager (RevMan) [Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014].

Articles that reported on the same potential risk factor, we combined the results and further analysed the data also using RevMan. The data were stratified into the following subgroups: preoperative motor strength was subdivided into severe (MRC 0–1) and moderate (MRC 2–3); duration of pre-operative weakness was divided into 6 weeks or less and more than 6 weeks; underlying pathology was grouped into disc herniation and non-disc herniation; type of disc herniation was divided into extruded or sequestered and finally age was grouped into 50 years old and under or over 50 years. A statistically significant association with a favourable outcome of improved foot drop weakness was defined as a  $P$ -value  $\leq 0.05$ .

## Risk of bias

The level of evidence provided by each individual study was classified as A, B or C according to the American Heart Association/American Stroke Association methods [41].

The quality of the studies was assessed using a combination of the relevant Graphic Appraisal Tool for Epidemiological studies (GATE) appraisal checklists and Newcastle–Ottawa Scale (NOS) guidelines in order to minimise bias [42, 43]. Each criterion was applied to each paper and was classified as either “good quality”, “fair quality” or “poor quality”. These are both validated and reliable tools [44].

## Patient and public involvement

There was no patient involvement in any aspect of this study. There is no intention to involve patients in dissemination of this study’s results.

## Results

### Study selection

The literature search resulted in a total of 797 articles as demonstrated in Fig. 3. From this, 64 articles were selected for abstract screening and further review in consensus by both reviewing authors (FS, SM). Then, 29 studies underwent full-text analysis independently by the two authors. Ultimately nine studies met the inclusion criteria.

There were a total of 431 patients who underwent surgical lumbar decompression for painful foot drop. Eight studies were of retrospective observational study design whilst one study was of a prospective study design, all providing level B evidence.

### Study characteristics

The nine included studies were all published in the English Language and the characteristics of each study are summarised in Table 2 [10, 13, 21–24, 29, 32, 45].

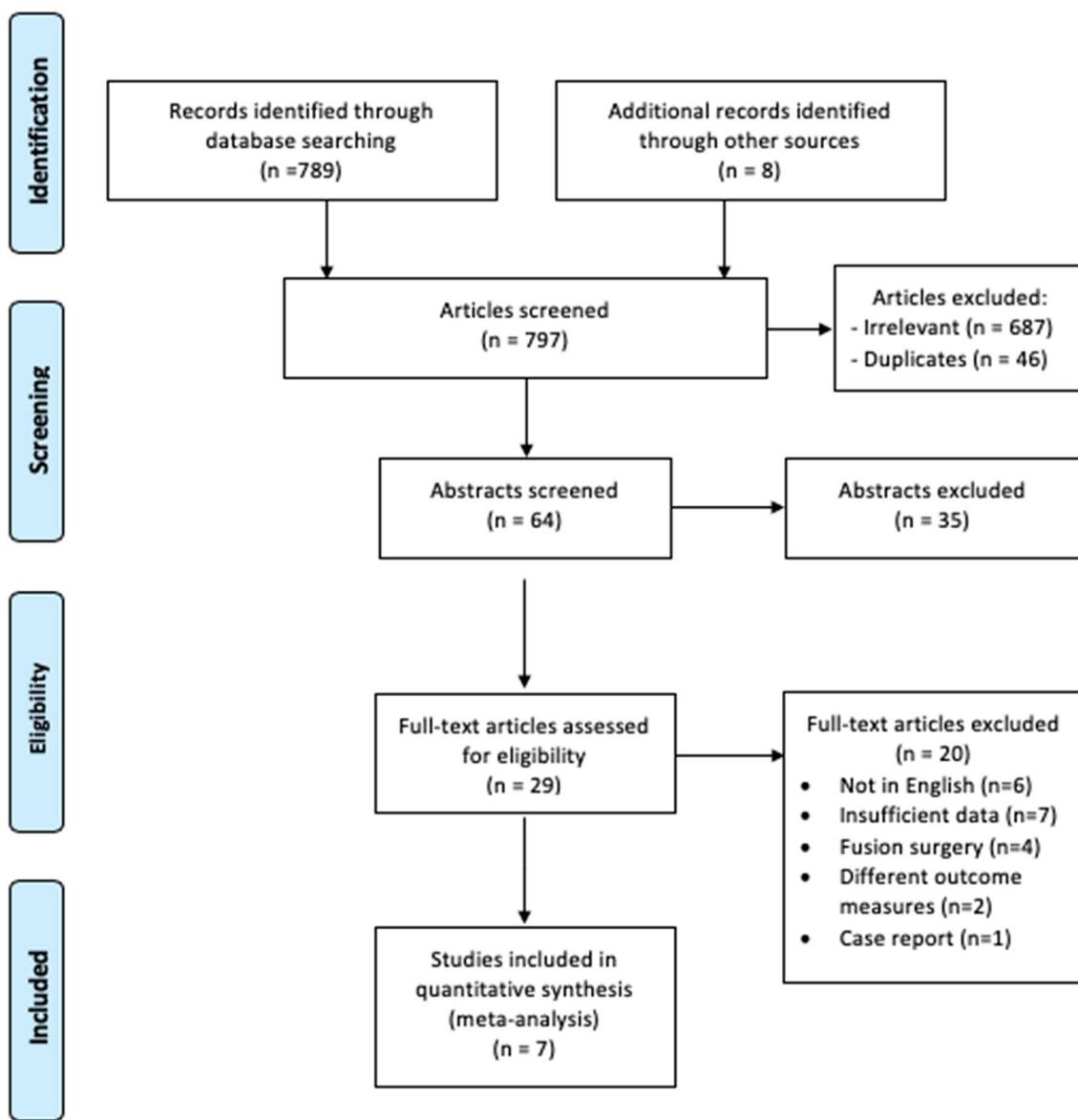
The majority of studies reported on foot drop specifically (77.8%,  $n = 7$ ). Median sample size was 43 (Range 26–83). The mean age of patients was 48 years with a predominance of males (59%).

### Pooled portion of outcomes following surgical intervention

All studies reported on the improvement of foot drop following surgical intervention and the pooled portion ranged from 67.9 to 96% across them with overall Mean improvement in outcome of 84.5% ( $SD = 9.35$ ). The Median follow-up period was 19.8 months (Range 4.5–126.7 months).

### Meta-analysis

From the nine original studies, 301 patients had extractable data for meta-analysis. An examination of the pooled portion of improved foot drop found no statistically significant difference between studies included in the meta-analysis ( $n = 7$ ,  $\bar{x} = 83.6\%$ , 95% CI 73.3–93.9) and those not included due to insufficient data ( $n = 2$ ,  $\bar{x} = 87.5\%$ , 95% CI 81.6–93.4;  $p = 0.54$ ).



**Fig. 3** PRISMA flow chart of the searched, identified and included studies for meta-analysis. PRISMA Preferred reporting items for systematic reviews and meta-analyses

### Preoperative muscle strength

For preoperative weakness, 6 studies had extractable data for the meta-analysis. Operating on patients with moderate weakness (MMT grade 2–3) preoperatively as opposed to severe weakness (MMT grade 0–1) was associated with lower odds of an unfavourable outcome when data were combined (OR 0.38, 95% CI 0.15–0.93; Fig. 4). As the confidence interval does not contain zero, there is strong evidence that on average the treatment effect is beneficial.

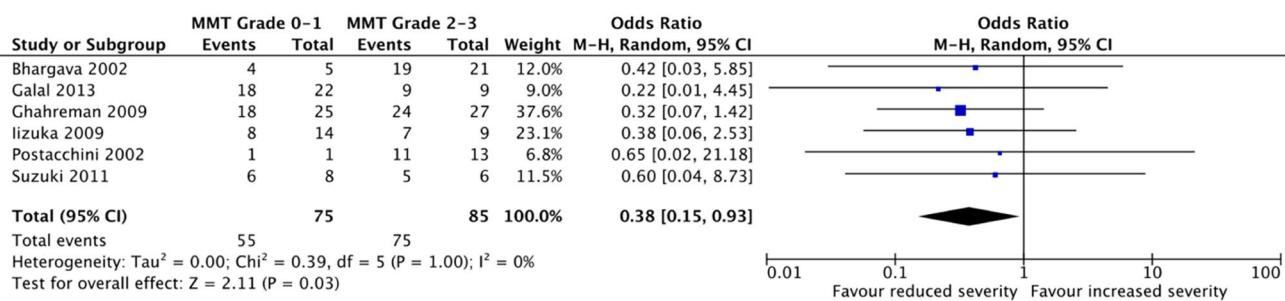
### Preoperative duration of foot drop

Operating more than 6 weeks of onset of foot drop weakness was associated with higher odds of an unfavourable outcome on aggregate analysis (OR 4.95, 95% CI 1.13–21.74; Fig. 5). As in Fig. 4, the Z-statistics indicates that the null hypothesis of no difference between the two treatments is being rejected at 5% level. However, as evident by the  $\chi^2$  test ( $p$ -value of 0.07) the null hypothesis that the true treatments effects are the same in all the primary studies included in meta-analysis is accepted at 5% level but not at 10%. The high  $I^2$  depicts the presence of heterogeneity, but this could be due to estimates showing the same direction of effect.

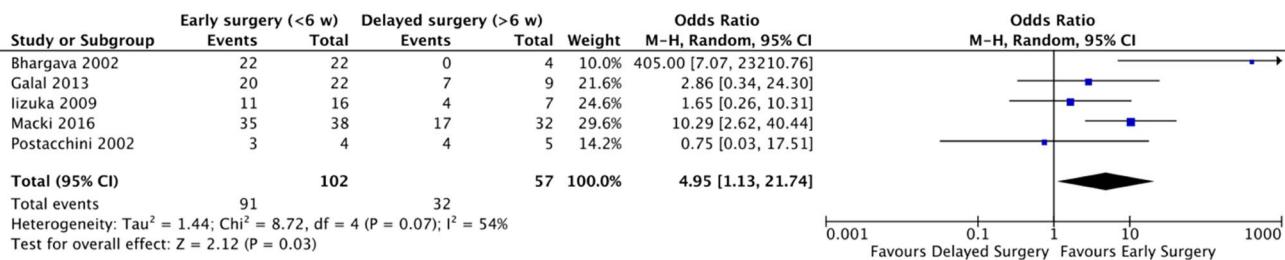
**Table 2** Studies evaluating outcome and prognostic factors of painful foot drop following surgical lumbar decompression surgery

Author, year, country	Study design	Date of data collection	Sample (N)	Mean age (years)	Male (%)	Definition of foot drop	Outcome	Prognostic factors
Davis R 1994 USA	Retrospective study	1959–1991	83	41	64	MMT < 3	Improvement in 91.6%	
Postacchini et al. 2002 Italy	Prospective study	1991–1997	51	49	66	MRC < 5	Improvement in 96%	1. Preoperative muscle strength ( $P=0.0046$ ) 2. Preoperative duration of muscle weakness ( $P=0.017$ ) 3. Non-contained disc herniation ( $P=0.038$ )
Iizuka et al. 2009 Japan	Retrospective study	1997–2007	28	55	57	MMT ≤ 3	Improvement in 67.9%	1. Post-operative improvement superior in disc herniation ( $P=0.011$ ) 2. Preoperative muscle strength in LSS ( $P=0.033$ )
Ghahrehman et al. 2009 Australia	Retrospective study	2001–2007	56	51	50	MMT < 3	Improvement in 80%	1. Age ( $P=0.03$ ) 2. Preoperative muscle strength ( $P=0.016$ )
Suzuki et al. 2011 Japan	Retrospective study	2000–2006	43	41.1	61	MRC ≤ 3	Improvement in 93%	1. Preoperative muscle strength ( $P=0.019$ ) 2. Non-contained disc herniation ( $P=0.012$ )
Bhargava et al. 2012 United Kingdom	Retrospective study	2004–2007	26	48	58	MRC ≤ 3	Improvement in 88%	1. Preoperative duration of foot drop ( $P=0.019$ )
Galal A 2013 Egypt	Retrospective study	2007–2012	31	45	45	MMT < 3	Improvement in 87.1%	1. History of diabetes ( $P=0.002$ ) 2. Diminution of preoperative radicular pain ( $P=0.0105$ )
Macki et al. 2016 USA	Retrospective study	1990–2012	71	55	66	MMT < 5	Improvement in 73.2%	1. Preoperative muscle strength ( $P=0.010$ ) 2. Preoperative duration of foot drop ( $P=0.004$ )
Albayrak et al. 2016 Turkey	Retrospective study	2006–2013	42	47	71	MMT < 3	Improvement in 83.3%	1. Preoperative duration of foot drop 2. Post-operative improvement superior in disc herniation 3. Presence of urinary incontinence

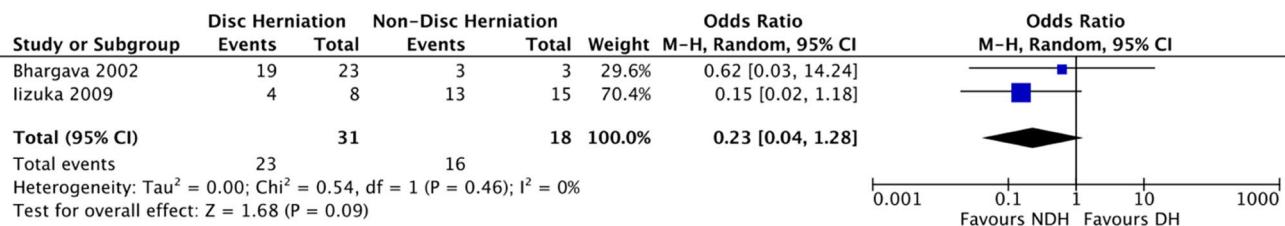
MMT Manual muscle testing; MRC Medical research council; N Number of patients; LSS Lumbar spinal stenosis



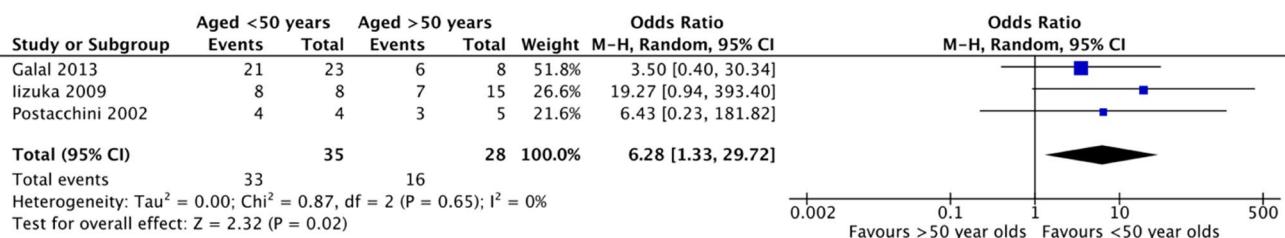
**Fig. 4** Forest plot showing odds of a favourable outcome after surgical intervention (decompression±discectomy) among patients with preoperative weakness of MMT grade 2–3 versus those with a preoperative weakness of MMT grade 0–1



**Fig. 5** Forest plot showing odds of a favourable outcome after surgical intervention (decompression±discectomy) among patients with preoperative duration of weakness for < 6 weeks versus those with a preoperative duration > 6 weeks



**Fig. 6** Forest plot showing odds of a favourable outcome after surgical intervention (decompression±discectomy) among patients without disc herniation versus those with disc herniation



**Fig. 7** Forest plot showing odds of a favourable outcome after surgical intervention (decompression±discectomy) among patients aged 50 years or less versus patients aged over 50 years

## Herniated and non-herniated disc pathology

Operating on patients with disc herniation and foot drop was not associated with a statistically significant reduction

in the overall odds of an unfavourable outcome (OR 0.23, 95% CI 0.04–1.28; Fig. 6) given that the confidence interval contains zero.

## Age

Surgery in the younger age group of patients conferred a more favourable outcome than in patients aged more than 50 years old (OR 6.28, CI 1.33–29.72; Fig. 7).

## Study quality

All nine studies included in analysis were assessed as being of good quality according to the Newcastle–Ottawa scale and GATE checklists. The limited overall quality of the included studies reflected the predominance of observational designs and the absence of high-quality RCTs. Further research is likely to affect confidence in the conclusions drawn from the current available literature [46].

## Discussion

The primary outcome measure for this study was improvement in foot drop weakness which was defined as an improvement of foot dorsiflexion post-operatively > pre-operative function, following surgical decompression. Pooled data analysis demonstrated a favourable outcome with surgery, particularly with meta-analysis indicating earlier surgery (< 6 weeks), moderate weakness (MMT grade 2–3) and younger age (< 50 years) suggesting a more favourable outcome. The presence of disc herniation does not statistically demonstrate an improvement in outcome although there was indeed a propensity towards an improvement in odds of a favourable outcome in those without disc herniation. The rate of recovery appears to also vary between studies from recovering immediately to up to 2 years after surgery [1, 23, 26, 31, 47].

In 1966, Andersson and Carlsson reported only 50% improvement in foot drop [2]. Prior to this, O'Connell produced a series, in 1951, documenting recovery rates of 22% [48]. The low rates of recovery of foot drop can be explained in twofold. Firstly, the authors focused on total recovery of foot drop as opposed to *any* improvement. Secondly, the patient population and surgical techniques have changed considerably since the 1950's.

Our results are consistent with other published literature reporting on prognostic indicators such as preoperative duration and grade of weakness on the outcome [1, 10, 13, 21, 24, 25, 27, 29, 49]. Macki et al. 2016 [13], reviewed 71 patients undergoing lumbar decompression for foot drop and reported an improvement of 73.2% in muscle weakness post-operatively whilst demonstrating preoperative muscle strength and palsy duration as significant prognostic factors. Postacchini et al. 2002 [21], demonstrated in their prospective study that patients who were operated on early (< 35 days) had greater recovery than those

undergoing surgery beyond 69 days. Similarly, Aono et al. 2007 [1], reported on a significant difference in outcomes based on duration of weakness with improved recovery rates in patients with shorter duration of foot drop. A retrospective study (2012) in our institution supported this finding with patients showing no improvement with a mean weakness of 18.3 weeks (24). Ondra et al. 2017 [49], found patients undergoing surgery within 48 h of onset of foot drop had better outcomes versus those beyond 48 h. Due to the variation in duration of palsy categories reported in the literature, it is difficult to directly compare the outcomes without the availability of raw data and this may explain the significant variances observed.

In contrast to the above, several other studies did not find any significant association between duration of palsy and outcome following surgical lumbar decompression [8, 20, 23, 27, 29]. This may partly be explained by patients not necessarily presenting with foot drop immediately particularly if the onset has been insidious and progressive. It may also be less apparent in the older age group who tend to have a gradual decline in mobility as they age. Both these factors would skew the accuracy of duration of palsy. Ghahreman et al. 2009 [23], in their retrospective study found no association between paresis duration and outcome however their time intervals ranged from 1 to 180 days with only two patients undergoing surgery beyond 3 months. Girardi et al. 2002 [8], also demonstrated no correlation between duration of foot drop and effect on recovery. Lonne et al. 2012 [27], stratified duration into groups (2 days, 6 days, 2 weeks and 1 month) but did not discover a correlation to outcome. The observed differences in these studies may be explained by their small sample sizes, the differences in time intervals chosen to prognosticate recovery as well as inherent bias within retrospective studies whereby recall regarding onset of weakness provided by patients may not exactly be accurate.

Majority of the published studies indicate preoperative muscle strength being a strong prognostic indicator for the outcome of improved or recovered foot drop following surgery in line with our findings [1, 10, 21, 27–29]. One study demonstrated weaker preoperative muscle strength as a risk factor for incomplete recovery particularly with MMT 0 or 1 [1]. Girardi et al. 2002 [8], did not find a relationship between this factor and outcome but the authors did suggest a trend towards statistical significance. Iizuka et al. 2009 [10], also reported on finding no correlation between preoperative muscle strength and post-operative improvement in strength. Like O'Connell et al. the authors outcomes differed and recovery was defined as MMT scoring of either 4 or 5 post-operatively in contrary to our outcome measure.

Advanced age was found to have a statistically significant association with unfavourable outcomes following decompression lumbar surgery in our meta-analysis. This finding

is consistent with results in three other studies that have also demonstrated this [20, 23, 50]. This finding may be explained by older patients usually having a chronic nature of symptoms with a combination of lumbar spinal stenosis with or without disc herniation. Following decompression, this may not improve if the chronicity has damaged the nerve permanently.

The commonest causes of foot drop include disc herniation and lumbar spinal stenosis [33]. Our data did not demonstrate any correlation between outcome and underlying aetiology (Fig. 6) in contrast to other studies. This was surprising as lumbar disc herniation is thought to cause mechanical disruption of nutritional supply to the nerve tissue and the duration of this could have a bearing on the likelihood of reversibility. We suspect our results are not statistically significant and not in line with these studies due to the small number of patients included in the analyses and would advocate further research to be conducted with this factor in mind.

Patient gender and type of herniated pathology did not affect foot drop outcomes. Other literature also supports this conclusion [1, 10, 20, 23, 27, 29]. Arinzon et al. 2004 [51], when comparing outcomes following decompression surgery in diabetic patients to non-diabetic patients, determined that patients with diabetes experienced greater motor weakness. We were unable to assess other factors such as the presence of specific co-morbidities, BMI and smoking status due to the lack of available raw data.

## Limitations

There are several limitations to this study. Firstly, the sample size is small but foot drop is a relatively uncommon presentation of lumbar degenerative disease. To ensure reduced bias, only studies with raw extractable data were included for quantitative analysis. Furthermore, the quality of the studies included are mainly retrospective observational in design. Retrospective studies have inherited bias which is unavoidable however with strict inclusion and exclusion criteria, we are able to reduce this. Another limiting factor is that none of the studies included a conservatively managed population. From experience and other published literature, it is known that some patients may eventually improve without surgery. The authors appreciate that there is a population who undergo conservative management before surgical treatment is offered and this is indirectly reflected in the population who underwent late surgery. Thirdly, the definition of foot drop varied within the literature however we defined this as a power of MMT grade 3 or less as this excludes patients with mild weakness as a result of associated pain and eradicates subjectivity. In addition to this, the duration cut offs varied considerably in the literature and again only extractable data were included which subsequently reduces

the sample size. Our study also only included patients with painful foot drop and would therefore not be applicable to patients with painless foot drop. Finally, we excluded studies not published in the English language and there were insufficient studies with extractable data and hence publication bias cannot be excluded.

## Conclusion

Foot drop is a serious and debilitating condition with long lasting effects for the affected persons. There are currently no randomised controlled trials published addressing this condition specifically. It is also evident from literature that there is no clear consensus on the management of foot drop. Recent published literature has indicated various efficacy of surgical management and the indications for surgery. This paper provides important information related to surgical outcomes of painful foot drop. To our knowledge, this is the first attempt at a meta-analysis to identify associations with favourable and unfavourable outcomes after lumbar decompression surgery for painful foot drop.

We have demonstrated age, preoperative muscle strength and duration of palsy, are all significant prognostic indicators of outcome of foot drop following surgical lumbar decompression.

Our meta-analysis sheds light on indication and timing of surgery. The results demonstrated better outcomes with earlier surgery (< 6 weeks), moderate weakness (MMT grade 2–3) and in patients aged < 50 years.

We propose a national and international database to collect multiple data on patients presenting with foot drop.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s00586-021-06936-8>.

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**Data availability** All data generated or analysed during this study are included in this published article [and its supplementary information files].

## Declaration

**Conflict of interest** The authors have no conflicts of interest to declare that are relevant to the content of this article.

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