Incidence of Epidural Fibrosis Following Primary Microdiscectomy

Ghazal Motazedian[1], Alexander Durst[2]

[1]Medical Student, Cardiff University; [2]Consultant Spinal Surgeon, Cardiff and Vale University Health Board

Objectives

To quantitively assess the incidence of epidural fibrosis following single-level primary microdiscectomy/discectomy at the L3/L4, L4/L5 and L5/S1 spinal levels.

Background

Lumbar discectomy, a minimally invasive spinal surgery is performed for the treatment of a herniated lumbar disc. As with any surgery, there is a risk of infection, scar tissue, haematoma, and recurrent symptoms. Epidural fibrosis is a natural post-operative complication of spinal surgery which has a controversial role in the prognosis of recurrent symptoms in a patient.

Methods

Our study was a service evaluation in the form of a retrospective observational study. Utilising clinical data from databases such as Bluespier and the Welsh Clinical Portal, we analysed 5809 patients. Our inclusion criteria involved patients who underwent single-level primary microdiscectomy and discectomy between 01/01/2013 and 31/12/2023, as shown in Table 1. This yielded 241 patients aged 14 – 83 years who were managed at the Cardiff and Vale University Hospital under the care of nine consultant spinal surgeons. The patient's clinical history was inspected from the date of the primary microdiscectomy onwards to identify any post-operative complications along with any patients who had revision surgery. We accessed patient MRIs through Synapse Radiology to identify epidural fibrosis and the MRI reports. Patients with repeat MRIs were categorised into ones with epidural fibrosis and ones without. We highlighted the proportion of patients with epidural fibrosis who underwent revision surgery, as seen in Figure 2. This data was used to assess the incidence of epidural fibrosis and its relationship with various variables such as the year of the event as seen in Figure 1, the patient's age, and the occurrence of revision surgery. This was done through IBM SPSS statistics software to run Chi-squared and Pearson correlation coefficient analysis to determine their significance.

Year	Number Of Patients	Repeat MRI	RDH	Epidural Fibrosis	Revisions
2013	27	14	13	5	3
2014	28	7	7	3	3
2015	35	18	18	8	9
2016	34	23	21	10	8
2017	26	16	16	8	7
2018	17	9	8	4	5
2019	16	3	3	2	0
2020	16	9	8	3	8
2021	18	3	3	0	1
2022	12	4	4	1	1
2023	12	6	6	2	4

Table 1: A table to show the total number of patients who underwent single-level primary microdiscectomy/discectomy (L3/L4, L4/L5, L5/S1) across 10 years (2013-2023), highlighting the number of repeat MRIs, Recurrent Disc Herniation (RDH), Epidural Fibrosis and Revisions post-surgery (n=241)

Results

Of the 241 patients, the incidence of epidural fibrosis following surgery was found to be 19.1% (n=46). This was most commonly seen in patients aged 30 – 39 years old. The Pearson correlation coefficient between the rate of epidural fibrosis and the discectomy year was -5.63 which signifies a strong negative correlation between the two variables. Following single-level primary microdiscectomy and discectomy, 46.5% (n=112) of patients experienced recurrent symptoms and had repeat MRI and of those 95.5% (n=107) had developed a recurrent disc herniation. The overall rate of revision surgery across the 10 years was 20.3% (n=49) of which 93.9% (n=46) was due to recurrent disc herniation. Inspecting the association between the presence of epidural fibrosis and the occurrence of revision surgery, we used the Chi-squared test to obtain a P-value of 1, indicating no association between the two. Furthermore, our results demonstrate that epidural fibrosis had the highest prevalence at the L5/S1 spinal level in 58.7% (n=27) of patients as seen in Figure 3.

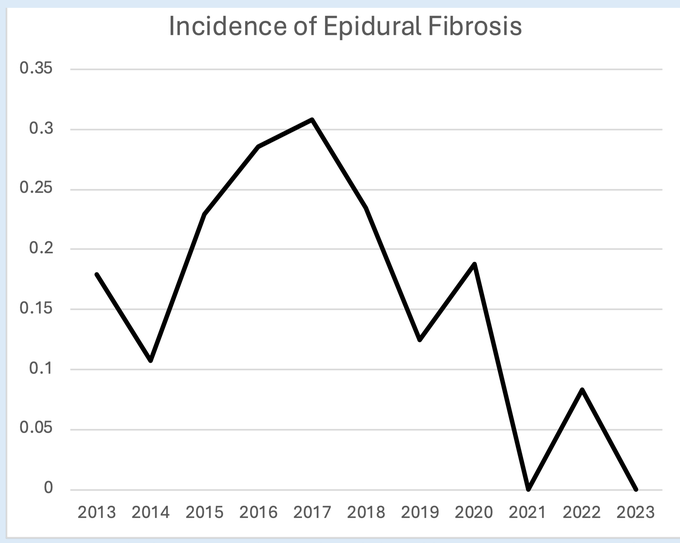

Figure 1: The incidence of Epidural Fibrosis identified on MRI scans post single-level primary microdiscectomy/discectomy (L3/L4, L4/L5, L5/S1) across 10 years (2013-2023) (n=241)

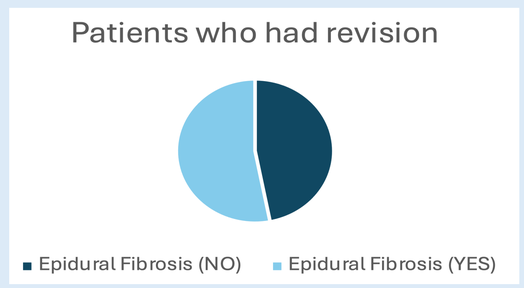

Figure 2: The number of patients undergoing revision surgery with/without epidural fibrosis as seen on MRI (n=49)

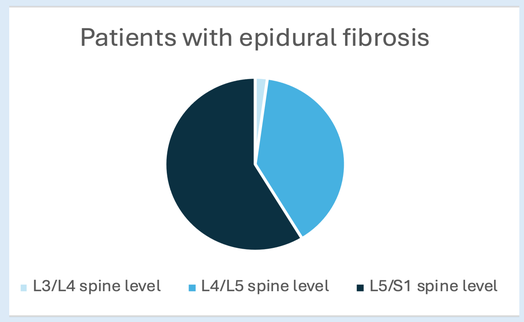

Figure 3: The number of patients with epidural fibrosis identified for each spinal level operated on(n=46)

Conclusion

Across the 10 years, there was a significant decrease in the presence of epidural fibrosis after the year 2017. We also found no association between the occurrence of revision surgery and the presence of epidural fibrosis. To ensure the credibility of the results, all patients in the criteria would ideally have had a repeat MRI as epidural fibrosis can also present in patients with good clinical outcomes following primary microdiscectomy. If taken further, the purpose would be to reduce the formation of epidural fibrosis, and the incidence of revision surgery, in the hope of better patient welfare and clinical effectiveness.

References:

1. Clinic C. Function of the Spine [Internet] Cleveland Clinic2023 [Available from: https://my.clevelandclinic.org/health/body/10040-spine-structure-and-function.
2. Clinic C. Herniated disk: Symptoms, Causes, Tests and Treatment [Internet]. 2021.
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Across the 10 years, there was a significant decrease in the presence of epidural fibrosis after the year 2017. We also found no association between the occurrence of revision surgery and the presence of epidural fibrosis. If taken further, the purpose would be to reduce the formation of epidural fibrosis, and the incidence of revision surgery, in the hope of better patient welfare and clinical effectiveness.

Epidural fibrosis following primary microdiscectomy

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Ethical approval: Not required

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Introduction

Lumbar discectomy is a minimally invasive spinal surgery performed to decompress or remove a herniated disc. Our spine is made up of 33 vertebrae which form the spinal canal. Between each vertebra sits an intervertebral disc which has a gel-like centre known as nucleus pulposus, surrounded by an outer ring, annulus fibrosus. The discs' purpose is to absorb shock and transmit load through the vertebral column (1).

With natural wear and tear, the annulus fibrosus can weaken and develop a tear, through which the nucleus pulposus can bulge. This is known as a herniated disc and if it compresses nearby nerves, it may induce significant pain in the corresponding myotomes e.g. sciatica. Other contributing factors to a disc rupture include heavy lifting, strenuous twisting, and trauma (1).

Treatment options vary from conservative management to minimally invasive decompressive surgery. Conservative treatment may be favoured in most cases to reduce post-operative complications such as infection, CSF leakage or spinal epidural haematoma. This would include using non-steroidal anti-inflammatory drugs (NSAIDs), physiotherapy and avoiding strenuous activity. There is also an option for the use of steroidal facet joint injections known as selective nerve block which can aid in dampening down severe chronic pain, however, there is poor evidence to support its long-term efficacy (2).

A meta-analysis of various cohort studies carried out on the incidence of spontaneous resorption of lumbar disc herniation revealed that in the United Kingdom, the incidence was 82.94%. This was generously higher than countries such as Japan with an incidence of 62.58%, which portrays the UK's excellent health care system (3).

Minimally invasive discectomy may be performed as a last resort which involves removing part of the disc which has bulged out and is compressing the nerves. This usually only requires a small skin incision posteriorly and the use of large tubes to reach the herniated disc (4).

One of the most common aftereffects of discectomy which may or may not cause complications, is the formation of fibrotic tissue around the area of the surgery, known as epidural fibrosis (5). This is usually identified by magnetic resonance imaging (MRI). Patients may need to have repeat MRIs if they experience recurrent symptoms or any other complications.

Our intention with this study was to assess the prevalence of epidural fibrosis following single-level primary microdiscectomy across 10 years and analyse the relationship between revision surgery and epidural fibrosis.

This will allow us to act according to the findings, in formulating recommendations for a better outcome following surgery.

Methodology

This paper reports a service evaluation on a 10-year quantitative analysis of the incidence of epidural fibrosis following primary microdiscectomy in the form of a retrospective observational design. Our evaluation took place at The University Hospital of Wales (UHW) in Cardiff, United Kingdom. Specifically, the data was collected from the Trauma and Orthopaedics department, from patients under the care of nine consultant spinal surgeons.

Utilising clinical data from the Bluespier clinical database and the Welsh Clinical Portal (WCP), we evaluated all patients from 01/01/2013 – 31/12/2023 undergoing single-level microdiscectomy and followed their journey throughout. We did this using patients' hospital numbers to access their records on both databases.

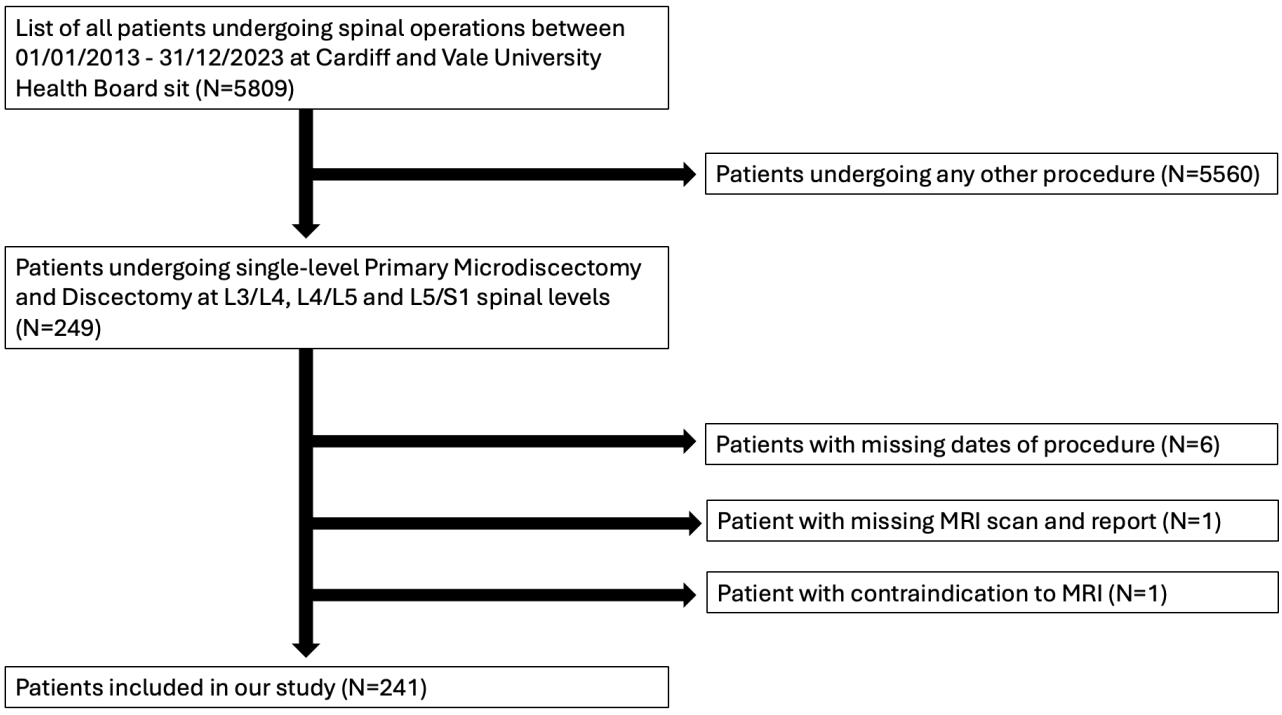
We investigated the rates of epidural fibrosis and recurrent disc herniation (RDH) following single-level discectomies. Additionally, the rate of epidural fibrosis was measured against variables such as the year of the procedure and the age range of the patient.

Each patient who had a repeat MRI was delved into further and the reason was noted down. MRIs were accessed through Synapse Radiology to observe if any epidural fibrosis was present, and the MRI reports were analysed thoroughly. Furthermore, we highlighted the patients who underwent revision following their surgery and the reasons for revision were noted.

Of the 5809 patients, the inclusion criteria included patients who had undergone primary microdiscectomies and discectomies at the L3/L4, L4/L5 and L5/S1 spinal levels as these are the most common sites of disc herniation; this yielded 249 patients. Exclusion criteria were patients undertaking other surgical interventions, as seen in Figure 1. One patient was excluded due to a missing repeat MRI and its report. One patient was also excluded as they were contraindicated from having an MRI due to aneurysm clips and had a Computed tomography (CT) instead. Six patients were excluded as the dates of their procedures were missing.

The data collected was analysed using IBM SPSS Statistics software version 29 to run Chi-squared tests and Pearson correlation coefficient to determine the significance between variables.

Figure 1: Flowchart summarising the inclusion criteria for our study.



Results:

Of the 241 patients analysed across the 10-year period, most patients were between 30 - 50 years of age (range 14 - 83). The total number of patients per year, the number who had a repeat MRI and of those, the proportion who had RDH as well as epidural fibrosis, are given in Table 1. The number of patients who had revision surgery per year is also noted.

Following surgery, 46.5% (n=112) of patients experienced recurrent symptoms varying from sciatica, cauda equina, urinary incontinence and paraesthesia and thus had a repeat MRI. Figure 2 shows the proportion of repeat MRIs across the years, with the most frequent being in 2016. Of these, 95.5% of patients (n=107) had a RDH as seen on their MRI, meaning an overall incidence of 44.4% of RDH following primary microdiscectomy. The remaining 5 patients had a clear MRI, CSF leak or a haematoma.

More importantly, our objectives were to determine the incidence of epidural fibrosis following primary microdiscectomy. Our results show that overall, 19.1% (n=46) of patients were found to have epidural fibrosis identified on MRI following surgery. Additionally, the rate of epidural fibrosis identified in patients having repeat MRIs was 41.1% and the incidence of revision surgery across 10 years was 20.3%(n=49) of which 93.9% (n=46) was due to recurrent disc herniation.

We categorized our collected data into age groups for observation as seen in Table 2. The prevalence of epidural fibrosis within age groups can be seen in Figure 4. Our results show that epidural fibrosis following surgery was most frequently seen in the 30-39 age group, followed by the 50-59 age group.

The relationship between epidural fibrosis and the number of revision surgeries was inspected, as seen in Table 3. Of the 49 patients who underwent revision surgery, 46.9% (n=23) had no epidural fibrosis and 53.1% (n=26) also had epidural fibrosis.

Furthermore, we looked at the correlation of the level of the primary discectomy with the formation of epidural fibrosis, as shown in Table 4. Out of the 46 patients with epidural fibrosis, 2.2%(n=1) was seen at L3/L4, 39.1%(n=18) was seen at L4/L5 and 58.7%(n=27) was seen at L5/S1 level.

Table 1:A table to show the total number of patients who underwent single-level primary microdiscectomy/discectomy (L3/L4, L4/L5, L5/S1) across 10 years (2013-2023), highlighting the number of repeat MRIs, Recurrent Disc Herniation (RDH), Epidural Fibrosis and Revisions post-surgery (n=241)

Year	Number Of Patients	Repeat MRI	RDH	Epidural Fibrosis	Revisions
2013	27	14	13	5	3
2014	28	7	7	3	3
2015	35	18	18	8	9
2016	34	23	21	10	8
2017	26	16	16	8	7
2018	17	9	8	4	5
2019	16	3	3	2	0
2020	16	9	8	3	8
2021	18	3	3	0	1
2022	12	4	4	1	1
2023	12	6	6	2	4

Table 2: A table to show the total number of patients who underwent single-level primary microdiscectomy/discectomy (L3/L4, L4/L5, L5/S1) across various age groups, highlighting the number of repeat MRIs, Recurrent Disc Herniation (RDH), Epidural Fibrosis and Revisions post-surgery (n=241)

Age range (Years)	Number Of Patients	Repeat MRI	RDH	Epidural Fibrosis	Revisions
<20	5	1	1	1	1
20-29	35	19	16	4	10
30-39	64	30	29	17	11
40-49	75	34	33	11	15
50-59	46	19	19	10	8
60-69	16	6	6	2	2
70<	6	3	3	1	2

Table 3: A table to show the number of patients undergoing revision surgery with/without Epidural Fibrosis as seen on MRI (n=49)

	Epidural Fibrosis (NO)	Epidural Fibrosis (YES)
Patients who had revision	23	26

Table 4: A table to show the number of patients with epidural fibrosis at the single spinal levels looked at (n=46)

	L3/L4 spine level	L4/L5 spine level	L5/S1 spine level
Patients with epidural fibrosis	1	18	27

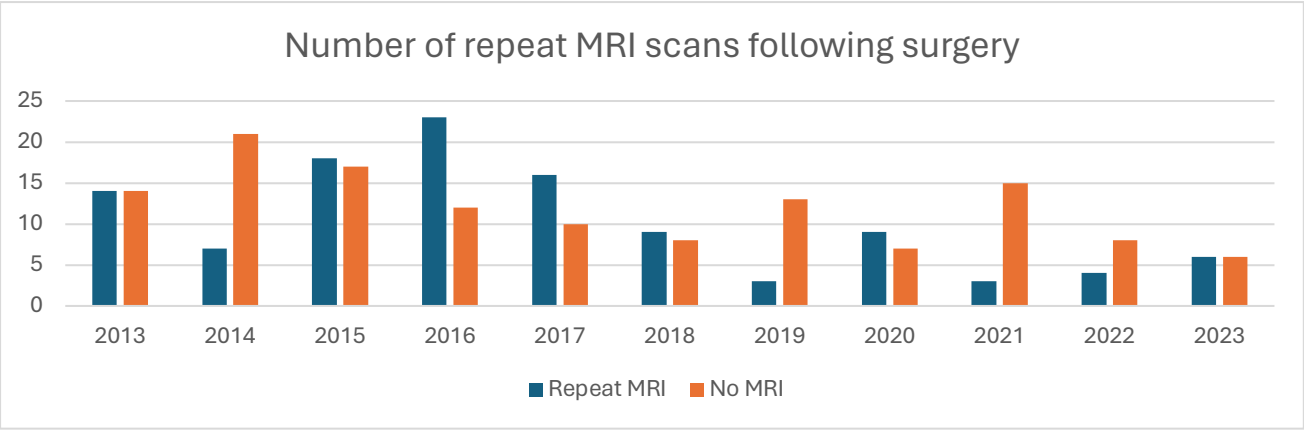
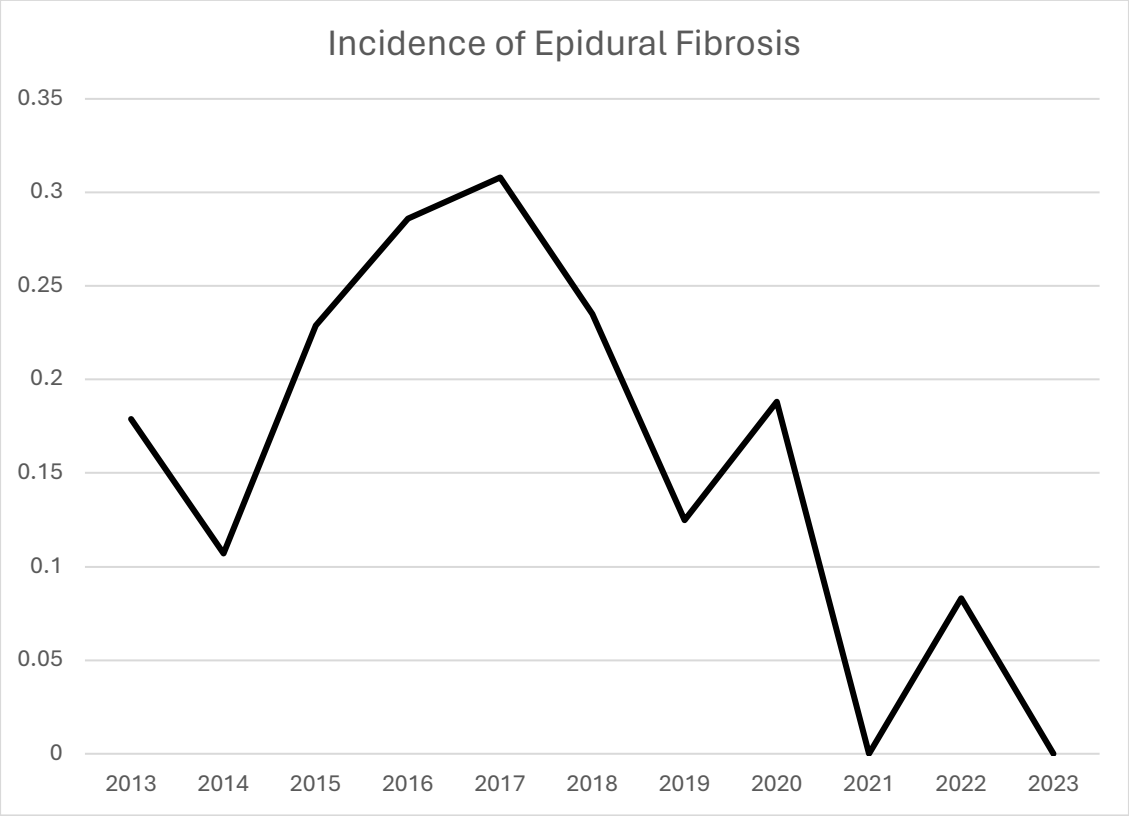


Figure 2: The total number of repeat MRI scans vs no MRI repeats following single-level primary microdiscectomy/discectomy (L3/L4, L4/L5, L5/S1) across 10 years (2013-2023) (n=241)



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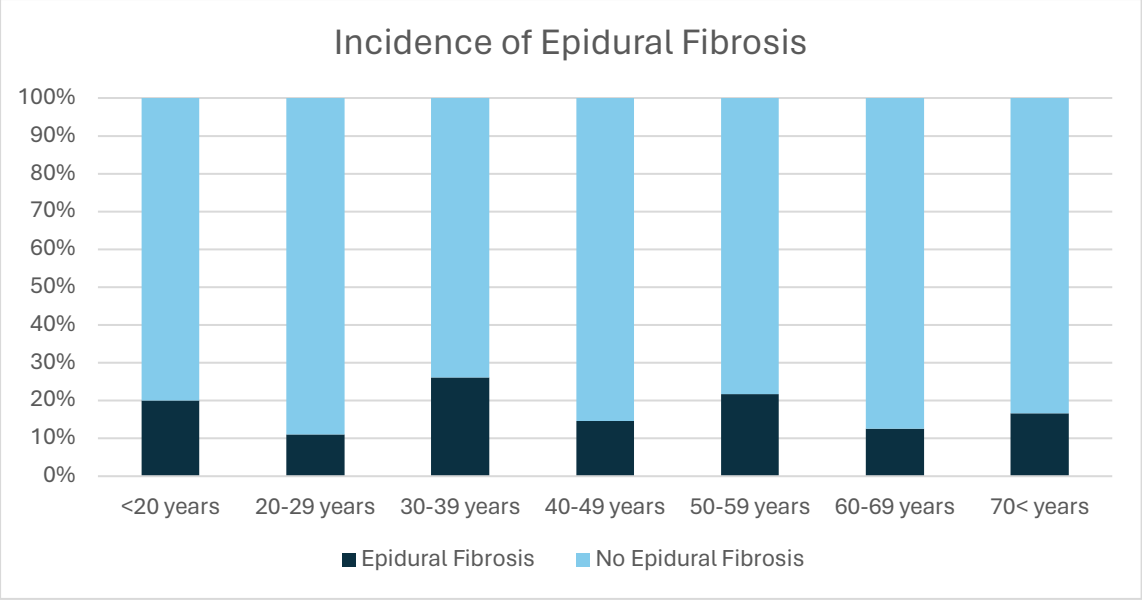
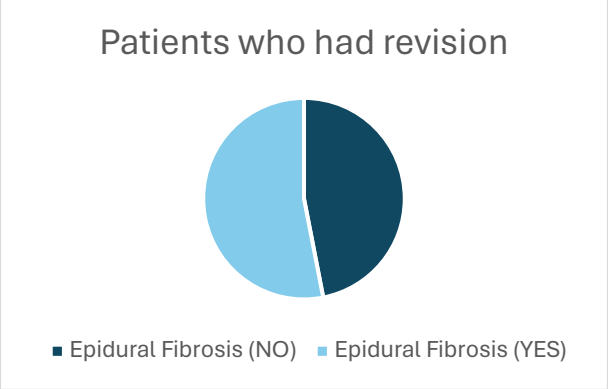


Figure 4: The incidence of Epidural Fibrosis identified on MRI scans post single-level primary microdiscectomy/discectomy (L3/L4, L4/L5, L5/S1) across various age groups (n=241)



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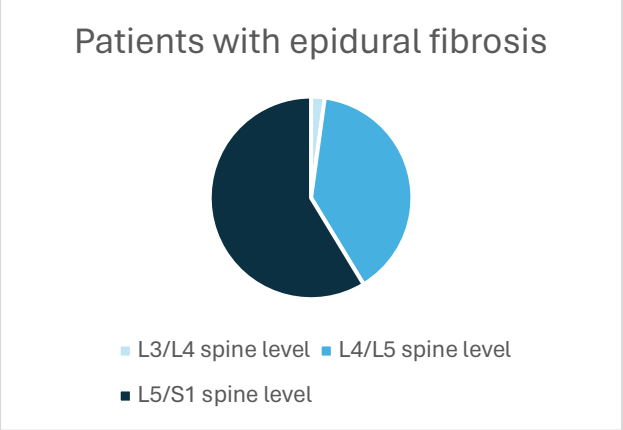

Figure 6: The number of patients with epidural fibrosis identified at each single spinal level operated on (n=46)

Discussion

Study results and significance

Overall, our study found that 19 out of 100 patients are likely to develop epidural fibrosis following primary microdiscectomy.

Inspecting the results, we established that across the 10 years, there was a sharp decrease in the incidence of epidural fibrosis identified in the later years as shown in Figure 3. To assess this further, we used the SPSS statistics software for the Pearson correlation coefficient to measure the strength and direction of the linear relationship between the year and the incidence of epidural fibrosis and obtained a result of -5.63. This negative correlation shows that in the later years, the incidence of fibrosis decreases. In this instance, the absolute value of the correlation coefficient (5.63) is substantially high, indicating a strong correlation between the two variables.

With 20 out of 100 patients undergoing revision surgery, we carried out a chi-squared test to determine if epidural fibrosis significantly affected the occurrence of revision surgery. Figure 5 highlights the proportion of patients undergoing revision surgery with/without epidural fibrosis. From the data in Table 3, we established a P-value of 1, meaning we failed to reject our null hypothesis that the occurrence of revision surgery is independent of the presence or absence of epidural fibrosis. This concludes that there is no significant association between epidural fibrosis and the occurrence of revision surgery.

When delving further into the association between age and the occurrence of epidural fibrosis, we found that age was not a driving factor for the incidence of epidural fibrosis, as seen in Figure 4.

Furthermore, Figure 6 shows the proportion of epidural fibrosis occurring at the 3 single spine levels we looked at. L5/S1 spinal level was found to have the highest incidence of fibrosis and this corresponds with L5/S1 being the most common site of disc herniation (6).

Additionally, our study revealed that 44 out of 100 patients develop RDH after primary microdiscectomy which is the most common reason for revision surgery. This statistic undermines the efficacy of primary microdiscectomy/discectomy in the treatment of a herniated disc.

Relevant findings from other studies

We implemented a literature search on existing research concerning this subject from 2000-2024. Using PubMed, our search strategy included:

((Epidural OR perineural OR peridural) AND (scarring OR fibrosis)) AND (Incidence OR rate) AND ("Primary microdiscectomy" OR discectomy OR microdiscectomy OR “back surgery”). The inclusion criteria of the papers found were based on the specificity of the study on the incidence of epidural fibrosis post microdiscectomy.

A particular observational study in the U.S.A. investigated the incidence and severity of epidural fibrosis after back surgery (7). This research looked at patients who underwent epiduroscopy after a diagnosis of Failed Back Surgery Syndrome (FBSS). Limitations of the study included a small sample size from a niche region, a single health centre in Texas. Significant fibrosis was identified in 91% of the 78 patients used in the study. Based on the techniques used to identify the fibrosis and the space occupying the scar, the incidence of fibrosis was found to be 95.6%. This in contrast to our results, shows a substantial, strong correlation between poor clinical outcomes following surgery and fibrosis. Our sample size was over 3 times larger than used in Bosscher’s study, thus making its reliability less convincing. It is also to be noted that epiduroscopy is far more sensitive in identifying fibrosis than MRI, which highlights one of the limitations of our study, as we used MRI only to identify epidural fibrosis. Epidural fibrosis may have been identified in more patients with recurrent symptoms if the epidural space was investigated endoscopically.

A second retrospective study in Turkey explored the primary reason for recurrent symptoms following lumbar disc surgery (8). Patients needing revision for a recurring disc herniation underwent MRI and epidural fibrosis was found to be the cause of 36.4% of persistent symptoms. These results correspond more closely with our findings on the rate of fibrosis reported on MRI reports of patients with recurrent symptoms following discectomy which was 41.1% (46/112).

Study limitations

Whilst our study has brought to light important points, a key limitation identified is the absence of MRI scans for every patient we looked at. Epidural fibrosis was looked for only in the patients who had a repeat MRI. This does not rule out the presence of epidural fibrosis in patients who did not have a repeat MRI, and we would be unable to analyse this as there are no MRI scans and reports to observe. If every patient in our inclusion criteria were to have a repeat MRI, we may have obtained different results and generated a different association between the presence of epidural fibrosis and the variables looked at.

It is also important to note that the following data was collated from one single hospital. To assess the reproducibility of this study, it would be important to compare our results to other hospitals, in other health boards, in other countries.

Conclusion

The incidence of epidural fibrosis following single-level primary microdiscectomy/discectomy has significantly reduced in the last 7 years. Although this may be due to the absence of follow-up MRIs, it is more likely to be due to new advancements in favour of reducing post-operative complications within the area of spinal surgery. Our study highlights the significant number of patients who experience post-operative complications and this needs to be further investigated to minimise the risks. If taken further, the purpose would be to reduce the formation of epidural fibrosis, and the incidence of revision surgery, in the hope of better patient welfare and clinical effectiveness.

References:

1. Clinic C. Herniated disk: Symptoms, Causes, Tests and Treatment [Internet]. 2021.
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