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Systematic Review of Surgery versus Conservative Management of Sciatica due to a Lumbar Herniated Disc

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Abstract

Sciatica is a medical condition characterized by pain going down the leg from lower back due to lumbar herniated disc which posing a great health burden and decrease patient's quality of life. The aim of the paper compares and summarizes the evidence regarding the effectiveness of surgery compared with conservative treatment for patients with sciatica due to lumbar disc herniation. At Department of Orthopedic Surgery, Al-Zahraa University Hospital, Faculty of Medicine for Girls, Al Azhar University for one year from 1st January 2021 to 30th December 2021. We conducted an electronic search through different databases; PubMed, SCOPUS, Web of Science, Cochrane Central Register of Controlled Trials (CENTRAL) and Google Scholar. We included clinical trials whether randomized or nonrandomized, prospective or retrospective, cohorts and case control studies. We included studies that compared surgery to non-surgical interventions and enrolled adult patients (more than 18 years of age) subjects with sciatica due to a herniated disc. We identified eleven studies that compared directly surgical treatment to conservative measures in patients with sciatica due to a lumbar herniated disc. Our main outcomes were Visual Analogue scale (VAS) at low Back or Leg pain, Oswestry Disability Index (ODI), Roland Disability Questionnaire (RDQ), and SF-36 scale at various points of follow up. VAS score showed surgical treatment had significant reduction in pain at short term and mid-term but on the long term there was no significant difference. While ODI showed significantly better results in the surgical arm at all points, short term, mid-term treatment and long term. Similarly, SF-36 scale showed significant difference favoring the surgical treatment. On the contrary, on RDQ, there was no significant difference between either arm, short term or long-term. Surgical treatment was superior to conservative treatment in the short term. However, it is not clear if this effect is sustained in the long term. Till now, in the absence of clear indications for surgery, the need for intervention is decided by the surgeon to determine which treatment strategy is best for them.

Keywords: Sciatica Conservative treatment Surgery Discectomy Systematic review" for published studies from 2000-2020.

1. Introduction

Sciatica is a medical condition characterized by pain going down the leg

from the lower back. This pain may go down the back, outside, or front of the leg.

[1]. The prevalence of sciatic symptoms reported in the literature varies considerably ranging from 1.6% in the general population to 43% in a selected working population [2].

About 90% of sciatica is due to a spinal disc herniation pressing on one of the lumbar or sacral nerve roots [3]. However, lumbar canal stenosis or foraminal stenosis and tumors or cysts are other possible causes. This study will be only restricted to herniation at the lowest three lumbar disc levels since these represent the most common sites. The most important symptom of sciatica is lumbosacral radicular leg pain that follows а dermatomal pattern radiating below the knee and into the foot and toes. The pain worsens with coughing; patients may report sensory symptoms, limited forward flexion of the lumbar spine, gait deformity and unilateral spasm of the Para spinal muscles. However, most patients present with a less clear clinical picture. In patients with persistent and severe symptoms who fail to improve following 6-8 weeks of nonsurgical treatment, imaging might be useful to identify the presence or absence of a herniated disc with nerve root compression [4] [5].

Physical examination largely depends on neurological testing. The most applied investigation is the straight leg raising test or Lasègue's sign. Patients with sciatica may also have low back pain but this is usually less severe than leg pain [6].

The only test with a high specificity is the crossed straight leg raising test, with a pooled specificity of 88% but sensitivity of only 29%, no history items or physical examination tests have both high sensitivity and high specificity. The pooled sensitivity of the straight leg raising test is estimated to be 91%, with a corresponding pooled specificity of 26% [7]. Conservative treatment for sciatica is primarily aimed at pain reduction, either by analgesics or by reducing pressure on the nerve root [8]. A recent systematic review found that conservative treatments do not improve the natural course of sciatica in most patients or reduce symptoms [7].

The primary rationale of surgery for sciatica is that surgery will relieve nerve root irritation or compression due to herniated disc material. The most common type of surgery is open micro-discectomy, surgical removal of part of the disc, performed with or without the use of an operating microscope or other magnifying tools. Other minimally invasive surgical techniques [2]. The objective of this systematic review is to compare and summarize the evidence regarding the effectiveness of surgery compared with conservative treatment for patients with sciatica due to lumbar disc herniation.

2. Material and Methods

We performed this systematic review and meta-analysis according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement and the Meta-analysis Of Observational Studies in Epidemiology (MOOSE) statement. PRISMA and MOOSE are reporting checklists for Authors, Editors, Reviewers of Meta-analyses of and interventional and observational studies. According to the International Committee of Medical Journal Association (ICJME), reviewers must report their findings according to each of the items listed in those checklists (Moher D, Liberati A, 2009).

2.1 Study Selection and Eligibility Criteria

The present review included studies that fulfilled the following criteria:

(1) Studies that included adults' patients (>18 years of age) with sciatica due to a lumbar herniated disc.

(2) Studies that included persistent radicular pain in the L_4 , L_5 or S_1 dermatome with or without mild neurological deficits.

(3) Studies that assessed the safety and effectiveness of surgical management of sciatica due to a lumbar herniated disc.

(4) Studies that compared surgical management with different conservative modalities.

(5) Studies that reported any of the following outcomes:

- Generic and specific validated clinical scores (e.g. ODI (Oswestry Disability Index) score and RMDQS (Roland and Morris disability questionnaire score)
- Low back and leg pain assessed by visual analogue scale (VAS).
- Health-related quality of life measures (e.g. Short Form-36).
- Serious adverse events including complications (e.g. infection, mortality), treatment failure, or long-term or persistent pain.
- Perceived recovery (e.g. subjective overall improvement, proportion of patients recovered).
- Return to activities (including sports and work).
- Patient satisfaction, including with cosmetic result; and/or Constant score.

(6) Studies that were randomized controlled trials (RCTs), comparative studies, prospective cohort, or retrospective chart studies.

We excluded.

- 1) Cauda equine syndrome or serve paresis.
- 2) History of unilateral disc surgery on the same level.
- 3) Malignancy.
- 4) Severe life-threatening or psychiatric illness.

2.2 Search Strategy and Screening

An electronic search was conducted from 2000 till December 2019 in the following bibliographic databases: Medline via PubMed, SCOPUS, Cochrane Central Register of Controlled Trials (CENTRAL), and Web of Science to identify relevant articles. We used different combinations of

the following queries: "sciatica" AND "back pain" AND "leg pain"; "disc herniation" AND "surgery" AND "conservative").

Data entry and processing were carried out using a standardized Excel sheet and reviewers extracted the data from the included studies. The extracted data included the following domains: (1) Summary characteristics of the included studies; (2) Baseline characteristics of studied populations; and (3) Study outcomes. All reviewers independently extracted data from the included articles and any discrepancies were solved by discussion.

2.3 Risk of Bias Assessment

The quality of the retrieved RCTs was assessed according to the Cochrane Handbook for Systematic Reviews of Interventions 5.1.0 (updated March 2011) using the quality assessment table provided in the same book (part 2, Chapter 8.5). The Cochrane risk of bias assessment tool includes the following domains: sequence generation (selection bias), allocation sequence concealment (selection bias), blinding of participants and personnel (performance bias), blinding of outcome assessment (detection bias), incomplete outcome data (attrition bias), selective outcome reporting (reporting bias) and other potential sources of bias. The authors' judgment is categorized as 'Low risk', 'High risk' or 'Unclear risk' of bias.

2.4 Dealing with Missing Data

Missing standard deviation (SD) of mean change from baseline was calculated from standard error or 95% confidence interval (CI) according to Altman (Altman and Bland, 2005).

2.5 Direct two-arm Meta-analysis

Continuous outcomes were pooled as mean difference (MD) or standardized mean

difference (SMD) using inverse variance method, and dichotomous outcomes will be pooled as relative risk (RR) using the Mantel-Haenszel method. The randomeffects method was used under the assumption of existing significant clinical and methodological heterogeneity. We performed all statistical analyses using Review Manager (RevMan) 5.3 or Open Meta-analyst for Windows.

2.6 Assessment of Heterogeneity

We assessed heterogeneity by visual inspection of the forest plots, chi-square, and I-square tests. According to the recommendations of Cochrane Handbook of Systematic Reviews and meta-analysis, chi-square p-value less than 0.1 denote significant heterogeneity while I-square values show no important heterogeneity 0% 40%, moderate between and heterogeneity from 30% 60%. to substantial heterogeneity from 50% to 100%. If any trials were judged to affect the homogeneity of the pooled estimates, we planned to perform a sensitivity analysis to assess outcomes with and without the trials that were affecting the homogeneity of the effect estimates.

2.7 Assessment of publication biases

We intended to test for publication bias using funnel plots if any of the pooled analysis included more than 10 studies in the review (Higgins 2011).

3. Results

In the present study, we searched Medline via PubMed, SCOPUS, Web of Science, Cochrane Central Register of Controlled Trials (CENTRAL), and Google Scholar from their inception till March 2020. The search retrieved 2289 unique records. We then retained 237 potentially eligible records for full-text screening. Finally, 11 studies were included.

3.1 Low Back/Leg pain (VAS)

Overall, seven studies compared the shortterm VAS outcome between surgical and conservative treatment. The overall effect estimates showed that surgical treatment led to significantly more reduction in VAS score than non-surgical treatment (MD -1.155; 95% CI, -2.2 to -0.09; P <0.001). The pooled studies showed significant heterogeneity (p =0.001; I² =93%) as shown in Figure .1. Two studies compared the mid-term VAS outcome between surgical and conservative treatment. The overall effect estimates showed that surgical treatment led to significantly more reduction in VAS score than non-surgical treatment (MD -2.16; 95% CI, -3.9 to -0.7; P < 0.001). The pooled studies showed significant heterogeneity (p =0.13; I² =55%, as shown in Figure .2. Six studies compared the long-term VAS outcome between surgical and conservative treatment. The overall effect estimates showed that surgical treatment led to a nonsignificant difference in VAS score compared to non-surgical treatment (MD -0.018; 95% CI, -1 to 0.96; P >0.05). The pooled studies showed significant heterogeneity (p =0.001; $I^2 = \bar{82\%}$) as shown in Figure .3.

3.2 Oswestry Disability Index (ODI)

Four studies compared the short-term ODI outcome between surgical and conservative treatment. The overall effect estimates showed that surgical treatment led to significantly more reduction in ODI score than non-surgical treatment (MD -11.2; 95% CI, -12.7 to -9.7; P <0.001). The insignificant pooled studies showed heterogeneity (p =0.47; I² =0%); as shown in Figure .4. Three studies compared the mid-term ODI outcome between surgical and conservative treatment. The overall effect estimates showed that surgical to significantly more treatment led reduction in ODI than non-surgical treatment (MD -7.1; 95% CI, -12.9 to -

1.16; P <0.001). The pooled studies showed significant heterogeneity (p =0.11; $I^2 = 55\%$) as shown in Figure .5. Three studies compared the long-term ODI between surgical and conservative treatment. The overall effect estimates showed that surgical treatment led to a significant difference in ODI compared to non-surgical treatment (MD -15.6; 95% CI, -29.1 to -2.1; P <0.05). The pooled studies showed significant heterogeneity (p =0.001; I² =90%), as shown in Figure .6.



Figure 1: Seven studies compared the short-term VAS outcome between surgical and conservative treatment.



Figure 2: Two studies compared the mid-term VAS outcome between surgical and conservative treatment.



Figure 3: Six studies compared the long-term VAS outcome between surgical and conservative treatment.



Figure 4: Four studies compared the short-term ODI outcome between surgical and conservative treatment.



Figure 5: Three studies compared the mid-term ODI outcome between surgical and conservative treatment.



Figure 6: Three studies compared the long-term ODI between surgical and conservative treatment.

3.3 Roland Disability Questionnaire (RDQ)

Two studies compared the short-term RDQ outcome between surgical and conservative treatment. The overall effect estimates showed that the difference between surgical and non-surgical treatment was not statistically significant (MD -0.407; 95% CI, -6.7 to -5.8; P >0.05). The pooled studies showed significant heterogeneity (p =0.003; I^2 =88%) as shown in Figure .7. Two studies compared the long-term RDQ outcome between surgical and conservative treatment. The overall effect estimates showed that the difference between surgical and non-surgical treatment was not

statistically significant (MD -0.511; 95% CI, -1.4 to 0.39; P >0.05). The pooled studies showed significant heterogeneity (p =0.38; I² =0%), as shown in Figure .8.

3.4 SF-36

Overall, seven studies compared the SF-36 outcome between surgical and conservative treatment. The overall effect estimates showed that surgical treatment led to significantly more improvement in SF=36 than non-surgical treatment (MD -1.155; 95% CI, -2.2 to -0.09; P <0.001). The pooled studies showed significant heterogeneity (p =0.001; I² =93%) as shown in Figure .9.



Figure 7: Two studies compared the short-term RDQ outcome between surgical and conservative treatment.



Figure 8: Two studies compared the long-term RDQ outcome between surgical and conservative treatment.



Figure 9: Seven studies compared the SF-36 outcome between surgical and conservative treatment.

4. Discussion

Lumbar disc herniation is a common cause of lower back pain and radiating pain to the lower extremities (Campbell et al. 2013) [9]. Usually, conservative therapy can improve the symptoms in most cases. In 10-20% of these cases, pain continues despite conservative therapy, and surgical treatment is considered (Parfenov and Golovacheva 2019) [10].

Conservative therapy mainly aims to reduce the associated pain and enhance mobility through medications, steroid physical injections, exercises, spinal manipulation, and traction (manual or mechanical) (Kılıç 2015) [11]. Other recent modalities have been developed such as bracing, electrical stimulation. transcutaneous electrical stimulation, and acupuncture (Kreiner et al. 2014) [12].

Surgical treatment is promoted in cases with neurologic deficits including altered bladder functions and progressive muscle weakness. These regarded as the only absolute indications surgical for intervention (Jna and Waddell 2007) [13]. Other relative indications for surgery vary among surgeons and patients. This was reflected in a cross-sectional study that was conducted in 89 countries to explore surgeon preference regarding different surgical and nonsurgical techniques, and factors influencing the outcome of surgery. 817 surgeons participated in the study. Severity of pain and disability (55.3%) was considered the most important indication for surgery, followed by failure of conservative treatment (50.6%), typical radiculopathy with neurological deficits (43.0%), and duration of complaints (36.2%). While the extent of disc herniation and patients' preferences were less important indications (Gadiradi et al. 2017) [14].

The primary rationale of surgery for sciatica is that surgery will relieve nerve root irritation or compression due to herniated disc material (Shepard and Cho 2019) [15]. However, in the absence of serious neurologic deficits or for persistent non-radicular low back pain, consensus on whether surgery is useful or not has not yet been established. Moreover, the timing of the intervention concerning prolonged conservative care has not been evaluated properly.

Hence, we conducted the current study in order to evaluate the literature to determine if surgical management is superior to the conservative approach to help the surgeon to take decision based on the recent available evidence.

We identified eleven studies that compared directly surgical treatment to conservative measures in patients with sciatica due to a lumbar herniated disc. Our main outcomes were Visual Analogue scale (VAS) at low Back or Leg pain, Oswestry Disability Index (ODI), Roland Disability Questionnaire (RDQ), and SF-36 scale at various points of follow up.

The surgical treatment had significant improvement on majority of the outcomes; VAS, ODI, and SF-36. However, VAS on the long term showed no significant difference. On the other hand, only two reported patient's subjective studies evaluation on RDQ. Both on the short and long term the pooled estimate showed nonsignificant difference. It is worth notice that in the short-term Burton et al. reported higher score in the surgical group but still was not significant. There was no consistency in reporting the magnitude of the surgical treatment effect; therefore, we further explored the included studies according to the nature of the surgical intervention.

Various operative techniques have been described for disc herniation. They are often categorized as open and minimally invasive surgeries. These techniques include open discectomy with many approaches has been introduced such as paracentral and Wiltse approaches, miniopen discectomy, microdiscectomy, and percutaneous endoscopic lumbar discectomy via interlaminar,

transforaminal, posterolateral, and trans iliac approaches (Amin, Andrade, and Neuman 2017) [16].

Discectomy was initially introduced in 1929 and later modified in 1938 to the technique practiced today; it has been regarded since then as a standard operative treatment for lumbar disc herniation (Benzakour et al. 2019) [17]. We identified three studies that compared discectomy to conservative care (Liang et al. 2015 [18]; Peul et al. 2008 [19]; Weinstein et al. 2006 [20]).

We found discectomy provided more rapid relief of leg pain, reassurance about recovery, and an earlier return to normal activities. However, the sustainability of this effect was controversial. Weinstein et al. reported that the benefit of surgery was seen early at 6 weeks and was maintained for at least 2 years (Weinstein et al. 2006) [20]. While Peul et al. reported the outcomes were similar between discectomy and conservative approaches by the end of one year and these did not change during the second year (Peul et al. 2008) [19].

Chemonucleolysis is another treatment regarded as modality which is an intermediate option between conservative management and open surgery. Although chemonucleolysis was introduced nearly 50 years ago, it did not gain much popularity (Antoniou et al. 2006) [21]. This technique depends on using certain enzymes to target the nucleus pulposus. Some of these enzymes had low specificity that might digest annulus fibrosus leading to adverse events i.e. cauda equina syndrome (Ishibashi, Iwai, and Koga 2019) [22]. A meta-analysis suggested that chemonucleolysis was superior to placebo and exerted effective clinical improvement but compared to surgery the evidence was not conclusive due to the heterogeneity of studies (Couto, De Castilho, and Menezes 2007) [23].

In our study, Burton et al. conducted a randomized clinical trial that compares chemonucleolysis to non-operative treatment. Both treatments had similar

outcomes regarding leg pain, back pain and satisfaction by patient 12 months. However, the non-operative group had significantly greater improvement in back pain and disability in the first few weeks (Burton, Tillotson, and Cleary 2000) [24]. The percutaneous approach is suitable mainly for small to medium-sized disc herniation to reduce the intradiscal pressure in the nucleus and create space for the herniated fragment to implode inward, thus reducing pain and improving mobility and quality of life (Singh and Derby 2006) [25]. It was proposed first in 1975 by Hijikata et al, who stated that 'Reduction of intradiscal pressure reduced the irritation of the nerve root and the pain receptors in the annulus and peridiscal area". These techniques involve the percutaneous removal of the nucleus pulposus by using a variety of chemical. thermal, or mechanical techniques (Kelekis et al. 2005) [26]. The percutaneous approach has several advantages over the open approach such as it requires no overnight hospitalization, and is performed without any epidural space violation or direct manipulation of the nerve root (Singh and Derby 2006) [25]. After our search, only one study compared disk decompression percutaneous to conservative treatment (Erginousakis et al. 2011) [27]. Percutaneous disk decompression achieved significant longterm improvement; however, in the early post-operative period (first 3 months) both percutaneous and conservative approaches. reduction Additionally, pain after percutaneous disk decompression occurred during the 1st month, was sustained for 2 years and had a significantly better outcome than conservative therapy. The least frequently reported method is

plasma disc decompression. This technique removes a portion of the nucleus pulposus of the herniated disc which in turn alleviates nerve root compression similar to percutaneous disk decompression (Cesaroni and Nardi 2010) [28]. Resulting in relieving the internal pressure that causes irritation of the neighboring nerve root (Eichen et al. 2014) [29]. This helps also in reducing the levels of local inflammatory mediators, and initiation of the healing process, all contributing to a lowering in discogenic pain (O'Neill et al. 2004) [30]. Gerszten et al. reported that both procedure resulted in improvement in back pain and quality of the life but , compared to conservative methods , plasma disc decompression resulted in much greater improvement without increase in the associated adverse events (Gerszten et al. 2010) [31].

Overall, or results are consistent with a previous meta-analysis that reported that t early surgery in patients with sciatica provides for a better short-term relief of leg pain as compared to prolonged conservative care, and no significant differences were found between surgery and usual conservative care in any of the clinical outcomes after 1 and 2 years (Jacobs et al. 2011) [32].

Although our results support the clinical efficacy of the surgical treatment over the conservative treatment on various outcomes, this does eliminate the

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5. Conclusion

Surgical treatment was superior to conservative treatment in the short term. However, it is not clear if this effect is sustained in the long term. Till now, in the absence of clear indications for surgery, the need for intervention is decided by the surgeon to determine which treatment strategy is best for them.

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