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Original Research

Day Care Spine Surgery Versus Conventional Spine Surgery: A Comparative Analysis

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ABSTRACT

Objective: To evaluate the effectiveness, cost-efficiency, and patient benefits of daycare spine surgery as compared to traditional spine surgery.

Materials & Methods: This study was conducted at the neurosurgery department of Bakhtawar Amin Trust and Teaching Hospital Multan from January 2022 to October 2023. This was a prospective study involving 103 patients diagnosed with cervical PIVD, lumbar PIVD, IDEM, and extradural spinal tumors. Participants were equally split into two groups, one undergoing daycare and another with conventional spine surgery. They were analyzed by Visual Analog Scale (VAS) score, Oswestry Disability Index (ODI), Neck Disability Index (ODI), time of operation, duration of hospitalization, cost of surgery, and follow-up duration.

Results: Results showed that daycare spine surgery had significantly less hospital stay duration (p-value < 0.01), low costs (p-value < 0.01), and low post-operative VAS scores (p-value < 0.05) relative to traditional spine surgery. Additionally, improvements in ODI and NDI scores were more in the daycare group (p-value < 0.01). The duration of surgery and blood loss was also less than the conventional surgery.

Conclusion: Daycare spine surgery has proved to be a better replacement for conventional surgery, having decreased resource use, enhanced cost-effectiveness, and better patient outcomes.

Keywords: Daycare spine surgery, conventional spine surgery, cervical prolapsed intervertebral disc (PIVD), lumbar prolapsed intervertebral disc (PIVD), anterior cervical discectomy and fusion (ACDF), Visual Analogue Scale (VAS) score, Oswestry Disability Index (ODI), Neck Disability Index (NDI), Intradural Extramedullary (IDEM) Tumor.

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INTRODUCTION

Spinal diseases are very common nowadays. These include degenerative, traumatic, infections, and tumors. Various genetic and environmental factors play an important role in the causation of these diseases. These diseases need treatment both medical and surgical. Surgical treatments were done conventionally by admitting the patients to the hospital, preoperative optimization, operative procedure, post-operative stay, discharge, and follow-up. Nowadays there is a trend of daycare spine surgery which includes the shortest hospital stay and timely discharge of the patients.[1,2]

Many specialties must examine patients when they are in the hospital for traditional spine surgery to manage them. Patients have multiple co-morbid diseases that need optimization. When patients are admitted to the hospital, they are evaluated by medical specialists, anaesthesiologists, and surgical teams. They are taking multiple medications like anti-platelets, and medications for diabetes and hypertension which need proper optimization and management. They are hospitalized preoperatively in various disciplines of medicine. Later patients are evaluated by anaesthesia specialists. They give anesthesia fitness for surgery. Then the surgical procedure is done. Later patients remain admitted in surgical ICU and later in neurosurgery wards.[3] Patients are managed post-operatively with medical management. During the postoperative period, some patients need blood transfusions depending on the hemoglobin status of the patient because some patients have pre-operative low levels. The majority of patients need rehabilitation protocol in the physiotherapy department. Patients are discharged with post-operative instructions and follow-up. In immediate post-operative follow-up, patients' wounds are assessed and their medications are reviewed. The stitches' status was assessed and removed. Some patients need radiological evaluation and rehabilitation evaluation. Patients' pain status was assessed and their disability status was assessed. The follow-up period varied but usually, it was 3 to 6 months. This is conventional spine surgery which is performed routinely.[3]

Nowadays there is a trend of **day care spine surgery**. In these cases, the patients are booked for surgery a few times ago. They are being optimized preoperatively by doing outpatient clinic visits to various disciplines. In daycare surgery, patients are discharged early with minimum postoperative stay. They return to their work early. They are being operated with smaller incisions with less tissue injury. They have less post-operative pain. Surgical procedures are carried out under local anesthesia, regional blocks, or general anesthesia. Patients have less cost of surgery. Another positive effect is less utilization of hospital beds and utilities leading to lower hospital costs. Shorter hospital stays lead to fewer hospital-acquired illnesses.[4,5]

Multiple surgical procedures are being done as daycare spine surgery. This is used in various procedures in general surgery. In spine surgery, daycare surgery is used in various surgical procedures. In degenerative spine diseases, daycare surgery is being done in cervical intervertebral disc herniation and lumbar disc herniation. In cervical disc herniation, the anterior cervical discectomy and fusion (ACDF) is done. The daycare spine surgery is performed in single or two-level ACDF. Previously, it was done in single-level diseases but nowadays two levels of ACDF can be performed as a day care surgery. In lumbar disc herniation, microdiscectomy or endoscopic discectomy procedures are routinely

carried out. In spinal tumors, the decision for surgical intervention depends on the location of the lesion. It can be done in extradural spinal tumors and intradural extramedullary spinal tumors. In intradural intramedullary spinal cord tumors day care spinal surgery cannot be done because they need prolonged postoperative care and rehabilitation. In intradural extramedullary tumors, daycare surgery can be done in cervical, thoracic, and lumbar lesions.[6]

The rationale of this study is to compare the surgical outcome of various spinal diseases in daycare spinal surgery versus conventional spinal surgery. While daycare spine surgery appears advantageous, there is a lack of comprehensive comparative studies. This study provides essential data-driven insights into the efficacy, safety, and patient satisfaction of both surgical methods, aiming to foster broader implementation and optimization of surgical care. This study has not been done previously in our setup and no statistical record is available regarding this topic. This will add to the local data on the epidemiology of the disease and help for the better management of the patients.

MATERIALS AND METHODS

Study Design

A prospective comparative study was done to thoroughly assess and differentiate the results of daycare versus traditional spine surgery. This method was chosen to establish the benefits and limitations associated with each surgical technique.

Study Setting

The research was done at the Neurosurgery Department Bakhtawar Amin Trust & Teaching Hospital Multan from January 2022 to October 2023. This hospital had advanced medical infrastructure and an experienced neurosurgery team, which were crucial for a study of this nature. Ethical approval from the hospital's ethical review board was taken.

Sampling Technique and Sample Size

103 patients from age 25 to 75 years who needed spine surgery were recruited in the study period. Informed consent from the patients in consent proforma was taken and they were told the disease status, its treatment options, surgical techniques both daycare and conventional surgery, study purpose, and outcomes. They agreed with this and gave informed consent. These patients were systematically assigned to one of two groups. One group was done with day care spine surgery and the second group underwent the conventional spine surgery approach. This stratification allowed us to conduct a detailed comparison of the outcomes from each surgical option. Patients were included by simple random sampling technique in this study. The sample size was calculated using the G-Power version 3.1.9.4 software. Considering the values of effect size as 0.3, alpha as 0.05, and power of the test as 80% a sample size of 159 was calculated. However, we took a sample size of 103 patients.

Inclusion Criteria

Patients between the ages of 18 and 65 were included in the study. They were diagnosed with cervical intervertebral disc herniation (PIVD), lumbar disc herniation (PIVD), intradural extramedullary tumors (IDEM) at cervical, thoracic and lumbar regions, and extradural spinal tumors.

Exclusion Criteria

Patients who had spine pathologies like spondylolisthesis, spine or pelvic tumors, infection of the spine, spine deformities like scoliosis and kyphosis, patients having neurological deficits, history of previous spine surgery, bedridden patients, and patients having serious comorbid

conditions such as cardiovascular or pulmonary diseases were unfit for anesthesia and patients having pregnancy were excluded from this study.

Surgical Protocols

Day Care Spine Surgery Protocol:

Pre-operative Protocol

In preoperative preparation for our spine surgery patients who require daycare spine surgery, were booked a week or so before the surgical procedure. They got all preoperative assessments by both a consultant neurosurgeon and an anesthetist.

Operative Protocol

All patients were admitted on the day of surgery. They were assessed by a consultant anesthetist and consultant neurosurgeon both in the pre-assessment bay. Some of these patients required local anesthesia for surgery and others required general anesthesia. The majority of minimally invasive spine surgeries were done in awake patients with local anesthetic blocks. Tubular retractors were required which can be managed per-operatively with blocks.

Immediate Post-operative Protocol

These daycare surgery patients were managed in the immediate postoperative period in the recovery room and adjoining HDU under the care of a consultant anesthetist team for a few hours for the management of vitals and intake output records and neurology.

Late Postoperative Protocol

They were handed over to the neurosurgical team in the neurosurgical ward later for further management. It depends on the type of spine surgery.

Cervical PIVD Surgery

These were mostly done from the anterior cervical region with a small scar on the side of the neck. These had a small drain on the side of the neck which was removed on the first postop day. A soft collar was advised around the cervical region. The patient sat up on the bed and walked after surgery on the first postoperative day. Urinary catheter if passed was removed on the same day after surgery when they were shifted to the ward. Patients were discharged on the first postoperative day.

Lumbar PIVD Surgery

Patients had a small wound at the back depending on the surgical technique used either via microscope or endoscope. Some patients required a small drain which was removed on the first postoperative day. Urinary catheter if passed was removed on the same day of surgery. A lumbosacral corset was applied to patients who experienced more pain after surgery. Patients were mobile in the immediate postoperative period. They were discharged on the same day or first postoperative day depending on the clinical status of the patient.

Spinal Tumour Surgery

Patients had a wound at the back may be minimally invasive or via conventional technique. The patients who required a small drain were removed on the first postoperative day. Urinary catheter if passed was removed on the same day of surgery or first postoperative. A lumbosacral corset was applied to some patients who experienced severe pain after surgery. Patients were mobile during the first postoperative period. They were discharged on the first or second postoperative day. The surgical wound healed in 10-14 days.

Conventional Spine Surgery Protocol

All patients underwent the standard pre-operative evaluation and preparation for surgery. General anesthesia was used for surgical procedures. After surgery, the patient remained admitted to the high dependency unit (HDU) and later to the neurosurgical ward. In the postoperative period, patients remained in the hospital for a few days and were then discharged with follow-up visits for wound assessment and management.

Data Collection

Data collection was done on the patients. Patient demographic variables include the age of patients, gender of patients, and distribution of disease by etiology. Visual analog score (VAS) pre-operative, VAS score post-operatively, waiting time for surgery in days, duration of symptoms in months, duration of surgery in hours, hospital stay in days, cost of treatment in rupees, blood loss in ml, and follow-up in months. Functional outcome scores including Oswestry Disability Index (ODI) and Neck Disability Index (NDI) were used both pre-operatively and post-operatively in both daycare spine surgery and conventional spine surgery. ODI is a disability index used in spine surgery procedures. It has five categories according to the level of disability. The first category is a minimal disability in which there is 0-20% disability, second category is a moderate disability category in which there is 21-40% disability, third category is the severe disability category in which there is 41-60% disability, the fourth category is a crippled category with 61-80% disability and last category is a bed-bound category with 81-100% disability. NDI is a disability score used for cervical spine cases and has 5 categories which are; no disability, mild disability, moderate disability, severe disability, and complete disability.

Statistical Analysis

SPSS 2021 software was used for data analysis. Descriptive statistics helped to summarize the demographic and baseline characteristics of the patients. Analytical analysis was done via independent sample t-test to compare means of the numeric variables like age of patients, VAS score pre-operative, VAS score post-operative, waiting time for surgery, duration of symptoms, surgery duration, hospital stay, cost of surgery, blood loss, and follow-up time in daycare surgery and conventional spine surgery. Data was collected on all these variables. The p-value was used to determine the level of significant relationship between these variables. If the p-value was <0.05, it was considered significant. This means there was a significant correlation between the variables in daycare spine surgery as compared to conventional spine surgery. So, the same variable was measured in day care spine surgery and also in conventional spine surgery and the results were significantly different.

Outcomes were compared using independent sample t-tests for continuous data, considering a p-value of <0.05 as statistically significant. For the ODI score, the scores of patients were calculated separately and categories were made based on these scores. Pre-operatively, the ODI score was calculated for daycare surgery and patients were divided into five categories depending on the level of disability and their percentage was calculated. Post-operatively, the ODI score was also calculated in these patients and they were categorized into the relevant categories, and their percentage was also calculated. The percentage change was calculated by taking the difference of pre-operative and post-operative percentage of the number of patients in each category. Preoperatively, conventional surgery patients were categorized according to their ODI score. The number of patients in each category was calculated and their percentage was calculated. Postoperatively the patients improved and were categorized again according to disability score. Their number and percentage were calculated again. Then the difference between the pre-operative percentage of the number of patients in

conventional surgery and the post-operative percentage of the number of patients in conventional surgery was calculated. In the end, this data was analyzed by independent sample t-test, and the value was calculated according to percentage change.

For the NDI score, the scores of patients were calculated separately and categories were made based on these scores. Pre-operatively, the NDI score was calculated for daycare surgery and patients were divided into five categories depending on the level of disability and their percentage was calculated. Post-operatively, the NDI score was also calculated in these patients and they were categorized into the relevant categories, and their percentage was also calculated. The percentage change was calculated by taking the difference of pre-operative and post-operative percentage of the number of patients in each category. Preoperatively, conventional surgery patients were categorized according to their NDI score. The number of patients in each category was calculated and their percentage was calculated. Postoperatively the patients improved and were categorized again according to disability score. Their number and percentage were calculated again. Then the difference between the pre-operative percentage of the number of patients in conventional surgery and the post-operative percentage of the number of patients in conventional surgery was calculated. In the end, this data was analyzed by independent sample t-test, and p value was calculated according to percentage change.

RESULTS

Demographic Analysis

Total number of patients were 103. Out of these patients, 58 (56.3%) were males and 45 (43.7%) were females. The mean age of patients was 47.84 ± 13.02 years with a minimum age of 25 years and a maximum age of 75 years.

This study rigorously evaluated the effectiveness and practicality of daycare spine surgery versus traditional spine surgery on 103 participants. Different spinal pathologies, like cervical PIVD, lumbar PIVD, IDEM, and extradural tumors were included in this study as they are

usually most cases in the Neurosurgery department of our institute. The detailed results given below show an overview of the pathologies, patient distribution according to pathologies, the hospital stay, duration of symptoms, cost of surgery, blood loss, hospital stay, gender distribution, and age distribution.

Distribution of Patients by Specific Pathology

We divided the patients according to their pathology. The total number of patients diagnosed to be having cervical PIVD was 22 (21.4%) in number and both the daycare group and the conventional group had equal numbers i.e. 11 patients each. Lumbar PIVD was the most common pathology. A total of 38 (36.9%) patients were diagnosed with this disease. Their distribution in the day care group and the conventional group is also equal having 19 patients in each group. For IDEM (Intradural Extramedullary Tumours), 26 patients (25.2%) were included in the study. These were equally divided, with 13 patients undergoing daycare surgery and 13 undergoing conventional surgery. Extradural spinal tumors accounted for 17 patients (16.5%) in the study. Nine patients underwent daycare surgery and eight underwent conventional surgery (Table 1).

Table 1: Distribution of Patients by Specific Pathology.

Specific Pathology	Number of Patients	Percentage of Total Patients
Cervical PIVD	22	21.4%
Lumbar PIVD	38	36.9%
IDEM	26	25.2%
Extradural SOL	17	16.5%
Total	**103**	**100%**

ANALYTICAL ANALYSIS

Cervical PIVD surgery (ACDF)

Cervical ACDF was done in 11 patients with daycare surgery and 11 patients with conventional spine surgery. Age distribution in day care ACDF was 30 to 50 years and in conventional surgery it was 32 to 55 years with mean ages 40.18 ± 7.07 and 42.55 ± 7.66 respectively, which has a p-value of 0.48 which was non-significant. The male-to-female ratio was 6 males versus 5 females in daycare surgery while 7 males versus 4 females in conventional surgery. The mean VAS score pre-operative was 7.36 ± 0.77 in daycare surgery and 7.55 ± 0.89 in conventional surgery having a p-value of 0.63 that is non-significant. The mean VAS score post-operative was 3.12 ± 1.21 in daycare surgery and 4.09 ± 1.04 in conventional spine surgery had a p-value of 0.04 which showed that it was significant. The mean waiting time was 18.32 ± 2.46 days in day care spine surgery and 26.49 ± 3.17 days in conventional spine surgery which had a p-value of 0.05 which showed that it was non-significant. The mean duration of spine surgery was 1.56 ± 0.37 hours in daycare spine surgery and 2.42 ± 0.45 hours in conventional spine surgery with a p-value of 0.02 which showed a significant correlation. The mean hospital stay was 0.67 ± 0.12 days in day care spine surgery and 3.32 ± 0.45 days in conventional spine surgery which had a p-value of 0.01 which showed a significant correlation. The mean cost of treatment was 47644.74 ± 9753.35 rupees in daycare spine surgery and 72789.46 ± 16537.80 in conventional spine surgery which had a p-value of 0.01. Perioperative mean blood loss was 103.31 ± 21.45 ml in day care spine surgery and 157.92 ± 37.11 ml in conventional spine surgery which had a p-value of 0.02 which also showed a significant correlation (Table 2).

Table 2: Cervical PIVD surgery.

Variable	Day Care	Conventional	Independent Sample t-test
No. of Patients	11	11	-
Mean age (years)	40.18 ± 7.07	42.55 ± 7.66	p-value = 0.48 t-test = -0.72 df = 20 CI (95%) = (-9.58 – 4.38)
Gender Distribution (Male/Female)	6/5	7/4	-
Mean VAS Score Pre-operative	7.36 ± 0.77	7.55 ± 0.89	p-value = 0.63 t-test = -0.50 df = 20 CI (95%) = (-1.06 – 4.38)
Mean VAS Score Post-operative	3.12 ± 1.21	4.09 ± 1.04	p-value =0.04* t-test = -2.45 df = 20 CI (95%) = (-1.77 – -0.17)
Mean Waiting Time (days)	18.32 ± 2.46	26.49 ± 3.17	p-value = 0.05 t-test = -7.75 df = 20 CI (95%) = (-10.39 – -6.22)
Mean Surgery Duration (hours)	1.56 ± 0.37	2.42 ± 0.45	p-value =0.02* t-test = -5.09 df = 20 CI (95%) = (-1.22 – -0.53)
Mean Hospital Stay (days)	0.67 ± 0.12	3.32 ± 0.45	p-value =0.01* t-test = -16.57 df = 20 CI (95%) = (-3.00 – -2.01)
Mean Cost (Rupees)	47644.74 ± 9753.35	72789.46 ± 16537.80	p-value =0.01* t-test = -2.86 df = 20 CI (95%) = (-46456.12 – -7311.34)
Mean Blood Loss (ml)	103.31 ± 21.45	157.92 ± 37.11	p-value =0.02* t-test = -2.68 df = 20 CI (95%) = (-101.22 – -10.38)

*p-value <0.05 is significant

Lumbar PIVD Surgery

In the Lumbar PIVD group, daycare surgery was performed on 19 patients, while conventional spine surgery was performed on another 19 patients. The mean age for daycare surgery was 43.89 ± 12.51 years, and for conventional surgery, it was 46.65 ± 14.39 years, which had a p-value of 0.36, indicating no significant difference. The male-to-female ratio was 12 males versus 7 females in daycare surgery and 11 males versus 8 females in conventional surgery. The mean VAS score pre-operatively was about 7 in both groups with a non-significant p-value (0.71). Post-operatively, the mean VAS score was 2.31 ± 0.29 in daycare surgery and 3.48 ± 0.77 in conventional surgery, which had a p-value of 0.04, indicating a significant improvement in the daycare group. The mean waiting time was 16.32

± 3.13 days in daycare surgery and 23.49 ± 5.29 days in conventional surgery, which had a p-value of 0.03, which is significant. The mean duration of surgery was 1.26 ± 0.31 hours in daycare surgery and 2.52 ± 0.74 hours in conventional surgery, which had a p-value of 0.02, indicating a significant difference. The mean hospital stay was 1.18 ± 0.14 days in daycare surgery and 4.21 ± 0.76 days in conventional surgery, which had a p-value of 0.01, showing a significant difference. The cost of treatment was 63542.56 ± 12138.23 rupees for daycare surgery and 87233.72 ± 18238.51 rupees for conventional surgery, which had a p-value of 0.01. Perioperative mean blood loss was 122.24 ± 23.42 ml in daycare surgery and 167.19 ± 32.59 ml in conventional surgery, which had a p-value of 0.06, indicating a nonsignificant difference (Table 3).

Table 3: Lumbar PIVD Outcomes.

Variable	Day Care	Conventional	Independent Sample t-test
No. of Patients	19	19	-
Mean Age (years)	43.89 ± 12.51	46.65 ± 14.39	p-value = 0.36 t-test = -0.94 df = 36 CI (95%) = (-8.89 – 3.29)
Gender Distribution (Male/Female)	12/7	11/8	-
Mean VAS Score Pre-op	7.32 ± 1.81	7.49 ± 2.01	p-value = 0.71 t-test = -0.38 df = 36 CI (95%) = (-1.01 – 0.71)
Mean VAS Score Post-op	2.31 ± 0.29	3.48 ± 0.77	p-value = 0.04* t-test = -5.38 df = 36 CI (95%) = (-1.67 – -0.69)
Mean Waiting Time (days)	16.32 ± 3.13	23.49 ± 5.29	p-value = 0.03* t-test = -5.36 df = 36 CI (95%) = (-11.51 – -5.35)
Mean Surgery Duration (hours)	1.26 ± 0.31	2.52 ± 0.74	p-value = 0.02* t-test = -6.46 df = 36 CI (95%) = (-1.72 – -0.74)
Mean Hospital Stay (days)	1.18 ± 0.14	4.21 ± 0.76	p-value = 0.01* t-test = -20.94 df = 36 CI (95%) = (-3.38 – -2.82)
Mean Cost (Rupees)	63542.56 ± 12138.23	87233.72 ± 18238.51	p-value = 0.01* t-test = -4.70 df = 36 CI (95%) = (-36577.53 – -12374.26)
Mean Blood Loss (ml)	122.24 ± 23.42	167.19 ± 32.59	p-value = 0.06 t-test = -2.03 df = 36 CI (95%) = (-92.27 – 0.63)

*p-value <0.05 is significant

Intradural Extramedullary Tumour (IDEM) Surgery

For IDEM, 13 patients underwent daycare surgery, and 13 patients underwent conventional spine surgery. The mean age in the daycare group was 48.79 ± 12.44 years, while in the conventional surgery group, it was 53.73 ± 15.29 years, which had a p-value of 0.25, showing no significant difference. The male-to-female ratio was 6 males versus 7 females in daycare surgery and 7 males versus 6 females in conventional surgery, which had a p-value of 0.89, which is non-significant. The VAS score pre-operatively was 6.34 ± 1.28 and 6.52 ± 1.42 in daycare group and conventional group, respectively. Post-operatively, the mean VAS score was 2.31 ± 0.47 in the daycare group and 3.98 ± 1.02 in the conventional surgery group, which had a p-value of 0.01, indicating a significant improvement in the daycare group. The mean waiting time was 19.23 ± 4.21 days for daycare surgery and 32.13 ± 6.36 days for conventional surgery, which had a p-value of 0.01, showing a significant difference. The mean duration of surgery was 2.13 ± 3.12 hours in daycare surgery and 3.69 ± 3.23 hours in conventional surgery, which had a p-value of <0.01, showing a significant difference. The mean hospital stay was 1.96 ± 0.42 days in daycare surgery and 5.42 ± 1.34 days in conventional surgery, which had a p-value of <0.01, showing a significant difference. The mean cost of treatment was 77342.32 ± 16531.63 rupees for daycare surgery and 101276.85 ± 21362.23 rupees for conventional surgery, which had a p-value of 0.03. Perioperative mean blood loss was 153.85 ± 34.29 ml in daycare surgery and 204.21 ± 38.13 ml in conventional surgery, which had a p-value of 0.04, indicating a significant difference (Table 4).

Extradural Spinal Tumour Surgery

In the extradural spine tumor group, 9 patients underwent day care surgery, and 8 patients underwent conventional spine surgery. The mean age was 56.32 ± 13.75 years in daycare surgery and 57.27 ± 14.42 years in conventional surgery, which had a p-value of 0.45, indicating no significant difference. The male-to-female ratio was 5 males versus 4 females in daycare surgery

Table 4: IDEM (Intradural Extramedullary Tumour) surgery outcomes.

Variable	Day Care	Conventional	Independent Sample t-test
No. of Patients	13	13	-
Mean Age (years)	48.79 ± 12.44	53.73 ± 15.29	p-value = 0.25 t-test = -1.18 df = 24 CI (95%) = (-13.52 – 3.52)
Gender Distribution (Male/Female)	6/7	7/6	-
Mean VAS Score Pre-op	6.34 ± 1.28	6.52 ± 1.42	p-value = 0.68 t-test = -0.42 df = 24 CI (95%) = (-1.10 – 0.72)
Mean VAS Score Post-op	2.31 ± 0.47	3.98 ± 1.02	p-value = 0.01* t-test = -4.37 df = 24 CI (95%) = (-2.39 – -0.98)
Mean Waiting Time (days)	19.23 ± 4.21	32.13 ± 6.36	p-value = 0.01* t-test = -6.00 df = 24 CI (95%) = (-19.58 – -8.42)
Mean Surgery Duration (hours)	2.13 ± 3.12	3.69 ± 3.23	p-value = 0.01* t-test = -2.36 df = 24 CI (95%) = (-2.72 – -0.37)
Mean Hospital Stay (days)	1.96 ± 0.42	5.42 ± 1.34	p-value = 0.01* t-test = -7.03 df = 24 CI (95%) = (-4.36 – -2.80)
Mean Cost (Rupees)	77342.32 ± 16531.63	101276.85 ± 21362.23	p-value = 0.03* t-test = -2.53 df = 24 CI (95%) = (-46030.21 – -5910.23)
Mean Blood Loss (ml)	153.85 ± 34.29	204.21 ± 38.13	p-value = 0.04* t-test = -3.36 df = 24 CI (95%) = (-97.90 – -4.48)

*p-value <0.05 is significant

and 4 males versus 4 females in conventional surgery. The mean VAS score pre-operatively was 8.14 ± 1.74 in the daycare surgery group and 8.02 ± 1.69 in the conventional surgery group, having a nonsignificant p-value of 0.73. Post-operatively, the mean VAS score was 3.46 ± 0.52 in daycare surgery and 4.21 ± 0.95 in conventional surgery, which had a p-value of 0.02, showing a significant improvement in the daycare group. The mean waiting time was 20.63 ± 3.27 days in daycare surgery and 28.55 ± 5.92 days in conventional surgery, which had a p-value of 0.05, indicating a non-significant difference. The mean duration of surgery was 2.35 ± 0.63 hours in daycare surgery and 3.11 ± 0.69 hours in conventional surgery, which had a p-value of 0.01, showing a significant difference. The mean hospital stay was 1.61 ± 0.28 days in daycare surgery and 5.14 ± 1.60 days in conventional surgery, which had a p-value of 0.01, indicating a significant difference. The mean

cost of treatment was 72214.23 ± 18429.61 rupees in daycare surgery and 97314.24 ± 23931.45 rupees in conventional surgery, which had a p-value of 0.01. Perioperative mean blood loss was 145.19 ± 35.54 ml in daycare surgery and 186.26 ± 39.21 ml in conventional surgery, which had a p-value of 0.03, indicating a significant difference (Table 5).

Table 5: Extradural spinal tumor outcomes.

Variable	Day Care	Conventional	Independent Sample t-test
No. of Patients	9	8	-
Mean Age (years)	56.32 ± 13.75	57.27 ± 14.42	p-value = 0.45 t-test = -0.78 df = 15 CI (95%) = (-6.55 – 3.05)
Gender Distribution (Male/Female)	5/4	4/4	-
Mean VAS Score Pre-op	8.14 ± 1.74	8.02 ± 1.69	p-value = 0.72 t-test = -0.37 df = 15 CI (95%) = (-1.19 – 0.83)
Mean VAS Score Post-op	3.46 ± 0.52	4.21 ± 0.95	p-value = 0.02* t-test = -2.67 df = 15 CI (95%) = (-1.36 – -0.15)
Mean Waiting Time (days)	20.63 ± 3.27	28.55 ± 5.92	p-value = 0.05 t-test = -2.78 df = 15 CI (95%) = (-10.58 – -1.82)
Mean Surgery Duration (hours)	2.35 ± 0.63	3.11 ± 0.69	p-value = 0.01* t-test = -2.62 df = 15 CI (95%) = (-1.31 – -0.10)
Mean Hospital Stay (days)	1.61 ± 0.28	5.14 ± 1.60	p-value = 0.01* t-test = -6.68 df = 15 CI (95%) = (-4.78 – -2.91)
Mean Cost (Rupees)	72214.23 ± 18429.61	97314.24 ± 23931.45	p-value = 0.01* t-test = -3.00 df = 15 CI (95%) = (-44308.96 – -7481.04)
Mean Blood Loss (ml)	145.19 ± 35.54	186.26 ± 39.21	p-value = 0.03* t-test = -2.48 df = 15 CI (95%) = (-73.83 – -4.17)

*p-value <0.05 is significant

ODI and NDI Scores

Ultimately, the functional recovery observed in both surgical methods is demonstrated by the pre- and post-operation disability outcomes, as measured by ODI and NDI scores.

ODI Scores

For the Oswestry Disability Index (ODI) scores, pre-operative scores for the daycare group had no patients in the minimal category, 13 (35.1%) patients in the moderate category, and 24 (64.9%)

patients in the severe category group and no patients in crippled and bed bound category. Post-operative scores in the daycare spine surgery group showed a significant change with 26 (70.3%) patients in the minimal category with a p-value of 0.001, 9 (24.3%) patients in the moderate category with p p-value of 0.45, and 2 (5.4%) patients in the severe group with p value 0.69. The number of patients in the crippled and bed-bound group remained zero post-operatively. These results showed that there was a significant increase in the number of patients in the minimal category group in the care surgery group. It means that in the daycare surgery, there is a decrease in the disability of patients post-operatively. Although there was no significant decrease in the number of patients in the moderate and severe disability groups still there is a decrease in the number of patients postoperatively in these groups which showed an improvement in the disability scores (Table 6).

In the conventional group, pre-operative scores had no patients in the minimal category, 8 (25.5%) patients in the moderate category, 25 (74.5%) patients in the severe category, and 3 (8.3%) patients in the crippled category. Post-operative scores were 18 (39.2%) patients in the minimal category with p value of 0.002, 13 (43.1%) patients in the moderate category with p value of 0.37, and 5 (17.6%) patients in the severe category with p value 0.67. There were no patients in bed bed-bound category pre- and post-operatively. These results showed that there was a significant increase in the number of patients in the minimal category group in the conventional surgery group. It means that in conventional surgery there is a decrease in the disability of patients post-operatively. Although there was no significant decrease in the number of patients in the moderate and severe disability groups still there is a decrease in the number of patients postoperatively in these groups which showed an improvement in the disability scores. The patients in the crippled category were improved and there were no patients in this category post-operatively (Table 7).

NDI Scores

For the Neck Disability Index (NDI) scores, pre-operative scores for the daycare group had no patients in the no disability category, 7 (46.7%)

Table 6: ODI Scores for Day Care.

ODI Categories	Pre-op Day Care (n, %)	Post-op Day Care (n, %)	Percentage Change	Independent Sample t-test
Minimal (0-20%)	0 (0%)	26 (70.3%)	+70.3%	p-value = 0.001* t-test = -5.43 df = 36 CI (95%) = (-0.98 – -0.52)
Moderate (21-40%)	13 (35.1%)	9 (24.3%)	-10.8%	p-value = 0.45 t-test = 0.77 df = 36 CI (95%) = (-0.16 – 0.35)
Severe (41-60%)	24 (64.9%)	2 (5.4%)	-59.5%	p-value = 0.69 t-test = 0.42 df = 36 CI (95%) = (-0.11 – 0.16)
Crippled (61-80%)	0 (0%)	0 (0%)	0%	-
Bed Bound (81-100%)	0 (0%)	0 (0%)	0%	-
Total	**37 (100%)**	**37 (100%)**	**0%**	-

*p-value <0.05 is significant

Table 7: ODI Scores for Conventional.

ODI Categories	Pre-op Conventional (n, %)	Post-op Conventional (n, %)	Percentage Change	Independent Sample t-test
Minimal (0-20%)	0 (0%)	18 (50.0%)	+50.0%	p-value = 0.002* t-test = -3.77 df = 34 CI (95%) = (-0.74 – -0.26)
Moderate (21-40%)	8 (22.2%)	13 (36.1%)	+13.9%	p-value = 0.37 t-test = 0.91 df = 34 CI (95%) = (-0.11 – 0.28)
Severe (41-60%)	25 (69.5%)	5 (13.9%)	-55.6%	p-value = 0.67 t-test = 0.43 df = 34 CI (95%) = (-0.14 – 0.22)
Crippled (61-80%)	3 (8.3%)	0 (0%)	-8.3%	-
Bed Bound (81-100%)	0 (0%)	0 (0%)	0%	-
Total	**36 (100%)**	**36 (100%)**	**0%**	-

*p-value <0.05 is significant

patients in the mild category, 8 (53.3%) patients in the moderate disability category, and no patients in the severe and complete disability group. Post-operative scores showed 6 (40.0%) patients in the minimal category with p value of 0.001, 7 (46.7%) patients in the mild category with p value of 1.00, and 2 (13.3%) patients in the moderate category with p value 0.58. This result showed that there was a significant rise in the number of patients in the no-disability group in daycare surgery post-operatively. Although not significant, there was a decrease in the number of patients in the moderate disability category of daycare surgery post-operatively (Table 8).

Table 8: NDI Scores for Day Care.

NDI Categories	Pre-op Day Care (n, %)	Post-op Day Care (n, %)	Percentage Change	Independent Sample t-test
No disability (0-20%)	0 (0%)	6 (40.0%)	+40.0%	p-value = 0.001* t-test = -5.20 df = 28 CI (95%) = (-0.68 – -0.32)
Mild disability (21-40%)	7 (46.7%)	7 (46.7%)	0%	p-value = 1.00 t-test = 0.00 df = 28 CI (95%) = (-0.29 – 0.29)
Moderate disability (41-60%)	8 (53.3%)	2 (13.3%)	-40.0%	p-value = 0.58 t-test = -0.56 df = 28 CI (95%) = (-0.90 – 0.52)
Severe disability (61-80%)	0 (0%)	0 (0%)	0%	-
Complete disability (81-100%)	0 (0%)	0 (0%)	0%	-
Total	**15 (100%)**	**15 (100%)**	**0%**	-

*p-value <0.05 is significant

Table 9: NDI Scores for conventional.

NDI Categories	Pre-op Conventional (n, %)	Post-op Conventional (n, %)	Percentage Change	Independent sample t-test
No disability (0-20%)	0 (0%)	4 (26.7%)	+26.7%	p-value = 0.001* t-test = -4.43 df = 28 CI (95%) = (-0.59 – -0.21)
Mild disability (21-40%)	8 (53.3%)	8 (53.3%)	0%	p-value = 1.00 t-test = 0.00 df = 28 CI (95%) = (-0.29 – 0.29)
Moderate disability (41-60%)	7 (46.7%)	3 (20.0%)	-26.7%	p-value = 0.58 t-test = -0.55 df = 28 CI (95%) = (-0.90 – 0.52)
Severe disability (61-80%)	0 (0%)	0 (0%)	0%	-
Complete disability (81-100%)	0 (0%)	0 (0%)	0%	-
Total	**15 (100%)**	**15 (100%)**	**0%**	-

*p-value <0.05 is significant

In the conventional group, pre-operative scores had no patients in the no disability category, 8 (53.3%) patients in the mild disability category, and 7 (46.7%) patients in the moderate disability category. Post-operative scores were 4 (26.7%) patients in the no disability category with p value 0.001, 8 (53.3%) patients in the mild disability category with p value 1.00, and 3 (20.0%) patients in the moderate disability category with p value 0.58. In the conventional surgery patients, there was also a significant increase in several patients in the disability group showing significant improvement. There was a decrease in several patients in the moderate disability group but that was not significant (Table 9).

DISCUSSION

Nowadays there are recent advances in surgical techniques in spine surgery. In conventional spine surgery, patients are admitted to the hospital for optimization, later evaluated by the neurosurgical team, and then operated. Postoperatively they remain admitted in HDU initially and later in the neurosurgical ward for a few days. Then they are discharged and follow-up is done. This increases the hospital stay, and economic load to both the patient and the hospital and also increases the chances of hospital-acquired infections. This study was done to evaluate the effectiveness of daycare spine surgery over traditional spine surgery. This research unequivocally highlighted the substantial benefits of daycare spine surgery over traditional inpatient procedures, primarily focusing on the aspects of clinical efficacy, cost-effectiveness, patient recovery, and long-term outcomes. This extended discussion delves deeper into how our findings align with, expand upon, or diverge from the current body of literature in spinal surgery practices, especially regarding minimally invasive techniques and outpatient care.[3,7]

In assessing the clinical efficacy and patient safety in spine surgery, the hospital stays of the patient had a significant role in the clinical outcome after surgery as it affects nosocomial infections. Thounaojam et al, (2021) also did a study that shows that shorter hospital stays reduce the risk of infection and complications.[1]

This study further substantiated this point by demonstrating not only reduced infection risks but also enhanced pain management, as reflected in the improved VAS scores. Agarwal et al, (2014) focused on patient education resources for minimally invasive and open spine surgery.[2] This emphasized the fact that daycare surgery not only reduces the risk of infection but also reduces post-operative pain which was proved by our study. The shortened hospital stays in this daycare surgery cohort supported a broader shift in surgical practices aimed at enhancing patient safety and reducing postoperative complications. These findings were crucial as they suggest that less invasive procedures could achieve the dual goals of effective pain management and rapid patient turnover without compromising safety.

The economy plays a very important role in the surgical management of patients. Patients need preoperative admissions and evaluation by multiple disciplines and investigations, and later on, surgical charges, hospital stay, medicines, and post-operative treatment at home. This point is important in the analysis of daycare versus conventional spine surgery. Momin AA et al, (2020) evaluated the evolution of minimally invasive surgery in lumbar spine surgery. Their study focused on surgical strategy as well as on the economic perspective of the technique. The emphasis on optimizing surgical approaches and resource utilization resonates with our findings regarding the benefits of daycare spine surgery in reducing healthcare costs and improving efficiency.[3] By minimizing the duration of hospital stays and the need for extensive postoperative care, daycare surgeries significantly cut down direct healthcare costs. Furthermore, it demonstrated that these surgeries could lead to broader societal cost savings by reducing indirect costs such as patient and caregiver lost workdays. The economic analysis from this study shed light on the cost reductions associated with daycare spine surgery as compared to conventional spine surgery. This economic benefit aligned with this study's findings and underscored the importance of adopting surgical approaches that are not only medically beneficial but also economically sustainable.

Disability assessment after spine surgery plays a crucial role in the outcome of the patients. The various parameters used are ODI and NDI scores. Park et al, (2022) compared minimally invasive biportal endoscopic spine surgery to conventional microscopic discectomy, suggesting that minimally invasive approaches may offer comparable or better outcomes in terms of postoperative pain, recovery time, and functional results.[4] This link between minimally invasive techniques and improved disability scores is significant as it demonstrates that innovative surgical approaches could lead to substantive enhancements in patient-reported outcome measures. This study's findings on the improvement in disability scores, particularly ODI and NDI, highlighted substantial enhancements in patients' quality of life. Such improvements are vital for patients' physical and psychological recovery, contributing to overall satisfaction with the surgical process and outcomes.

The safety profile of spine surgery is very important. If minimally invasive techniques were used for daycare surgery, the postoperative outcomes and safety profiles would be good. Simpson et al, (2020) discussed complication rates in outpatient versus inpatient spine surgery, highlighting the safety and feasibility of outpatient spine surgery.[6] This is particularly relevant given the ongoing concerns regarding the overuse of invasive procedures in cases where less invasive options may suffice. This study not only supported this view but extended it by quantitatively demonstrating that careful patient selection could lead to excellent outcomes in terms of safety and effectiveness.

The long-term outcomes after surgery are the actual results of the surgical procedure. This is important to discuss in daycare versus conventional spine surgery. Zhang et al, (2023)

compared outcomes between conventional lumbar fenestration discectomy and minimally invasive lumbar discectomy, finding that the latter resulted in faster recovery, shorter hospital stays, and lower complication rates. These findings align with our study, supporting the trend toward minimally invasive spine surgery.[5] This aligned with our observations of sustained improvements in postoperative functionality and pain reduction. These insights are crucial for understanding the trajectory of patient recovery and satisfaction over time.

The advancement in surgical techniques, especially the shift towards minimally invasive procedures had a profound impact on the practice of spine surgery. Katz et al, (2023) discussed the evidence, techniques, trends, and future projections of spinal endoscopy.[8] These advancements facilitated the adoption of daycare surgeries by reducing the physical trauma associated with surgery, thereby enabling quicker recoveries and shorter hospital stays. Pennington et al, (2018) conducted a systematic review comparing minimally invasive versus conventional spine surgery for vertebral metastasis. Their findings support our conclusion that minimally invasive approaches offer comparable outcomes to conventional surgery, with potential advantages in terms of reduced blood loss, shorter hospital stays, and faster recovery.[9]

Malik et al, (2021) analyzed robotic-assisted versus conventional posterior lumbar fusion, focusing on complications and readmissions.[11] Although our study didn't specifically address robotic-assisted surgery, the broader trend toward technological advancements in spine surgery, as highlighted in their study, underscores the ongoing evolution and improvement of surgical techniques and approaches.

The improved recovery patterns and enhanced quality of life in our daycare cohort, as compared with traditional care patients, underscored the patient-centered benefits of modern surgical approaches. Elgamal et al, (2023) observed similar patterns, noting that patients from daycare settings tend to experience quicker improvements in terms of physical function and overall well-being.[10] This observation is crucial as it points to the broader applicative benefits of daycare surgery, not only in terms of clinical and economic outcomes but also in enhancing the postoperative quality of life for patients.

In this study, some variables had significant correlations as the p-value was < 0.05. VAS post-operative score, surgical duration, duration of hospital stays, and the cost of surgery, were significant in the pathologies like cervical PIVD, lumbar PIVD, IDEM, and extradural spinal tumors. Blood loss was significant in Cervical PIVD, IDEM, and Extradural spinal tumors but not in Lumbar PIVD in this study.

VAS score post-operative was significant for all the pathologies. This result showed that in comparing the results of daycare surgery and conventional surgery there was a significant difference in post-operative VAS in both groups. VAS score post-operative was significantly less in the day care surgery group which means the recovery of pain was better in day care surgery patients as compared to conventional spine surgery patients.

Surgical duration was significant in all the pathologies. In the care surgery group, minimally invasive techniques were used that decreased the time of surgery for all the pathologies with careful patient selection. The significant p-value showed that the surgical duration was significantly less in the day-care group as compared to the conventional group due to the large and invasive procedures. This results in better post-operative recovery.

Hospital stay was less in daycare group patients because they were admitted after complete pre-op workup and discharged on the same day of surgery due to minimally invasive surgery good patient recovery and no need for prolonged monitoring. This was shown by the significant p-value which shows that hospital stay

was significantly less in the care surgery group.

The cost of surgery also showed a significant difference between the daycare and conventional spine surgery groups in all the pathologies. Less surgical time and hospital stay were the reason that the cost of surgery in the daycare group was economical. Therefore, the p-value was significant showing that the cost in the care group was significantly less than the conventional group.

Blood loss also showed a significant difference between the daycare surgery and conventional spine surgery group in cervical PIVD, IDEM, and extradural spine tumor cases. The significant p-value of blood loss in these cases meant that the blood loss was significantly less in the care group due to the use of minimally invasive techniques and less tissue trauma.

LIMITATIONS

One limitation of our study was that we had not used the endoscopic spine surgery technique because of its unavailability. We used minimally invasive techniques for daycare spinal procedures. The second limitation was that we couldn't include spinal trauma in the study because in this study we did elective surgeries and no emergency cases could be included. The third limitation was that we couldn't include intramedullary spinal tumors as they require intense post-operative monitoring for a few days and in our setup, it wasn't possible as it's not as advanced.

CONCLUSION

The results from this study comparing daycare and conventional spine surgery offer strong support for choosing daycare surgery for patients with lumbar disc herniation. The advantages are clear: shorter surgery times, less blood loss, faster recovery, and greater patient satisfaction. These benefits demonstrated how daycare surgery can substantially enhance patient outcomes and make more efficient use of healthcare resources. However, expanding daycare spine surgery more broadly will necessitate thoughtful planning around logistics, training, and infrastructure.

Implementing day-care spine surgery as a routine practice could revolutionize spinal healthcare. It promotes quicker recoveries and lowers healthcare costs, aligning perfectly with the goals of contemporary healthcare to be effective, efficient, and focused on patient care.

Declaration of Patients' Consent

It is certified that proper informed consent was taken from all patients in the patient's consent form. The patients were properly informed about the disease, its stage, various treatment options, and all types of surgical techniques including daycare and conventional techniques. All of the patients understood all clinical data and that their identity, images, and clinical information would be used for research purposes and their names and identities would be masked in the journal.

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Additional Information

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Human Subjects: Consent was obtained by all patients/participants in this study.

Conflicts of Interest:

In compliance with the ICMJE uniform disclosure form, all authors declare the following:

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AUTHORS CONTRIBUTION

Author's Full Name	Intellectual/Contribution to Paper in Terms of:
1. Waqas Noor Chughtai	1. Study design and methodology.
2. Muhammad Usama	3. Paper writing, referencing, and data calculations.
3. Hafiz Muhammad Ayyaz Afzal	2. Data collection and calculations.
4. Muhammad Habib Hassan	4. Analysis of data and quality insurer.
5. Nauman Ahmad	5. Analysis of data and interpretation of results.
6. Tahira Fatima	6. Literature review and manuscript writing.