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Spinal surgery Success Rates and What Defines Success. A Review

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Abstract

The success with long-term usage of spinal surgery is very low and skewed and in most cases the outcomes are similar to those of shoulder surgery. Despite the decades of innovations and different approaches to functioning in terms of degenerative, traumatic, deformity, and neoplastic spine conditions, the results remain mixed across researches. The lack of a consonant, patient-based intuition concerning the concept of success is one of the primary factors, which caused this difference. The subdued patient-reported outcomes usually entail alleviation of pain, functional healing, restoration, and sustainability in the quality-of-life. Critical synthesis of the available evidence on the outcomes of spinal surgery in the review establishes gaps in the relationship that underlies between the success of the procedures and benefit to the patient in the long term. We believe that a revision of spinal surgery success definition is required depending on the multidimensional approach with longitudinal functions and patient-reports outcomes being the most significant outcomes compared to technical success that enables to compare procedures more appropriately and aligns the interests of patients better.

Keywords

Spinal surgery; Surgical outcomes; Success rate; Patient-reported outcomes; Lumbar fusion; Spinal decompression; Definitions of success.

Introduction

Spinal disorders remain among the main causes of disability, socioeconomic impairments, and essential losses in productivity and quality of life in the world (Global Burden of Disease Study, 2023). The long-term success of spinal surgery is not wholly stable despite decades of establishment as a fundamental modality (particularly in comparison with degenerative, traumatic, and deformity-related diseases) and long-term outcomes of this procedure may be comparable to those of shoulder surgery.

Over the past 3 decades, it has been noticed that an array of innovations is highly marketed, including robotics, advanced fusion constructions, computer navigation, and minimally invasive procedures, which expand the number of operative options. Nevertheless, the technological advances have not been translated into the improved patient outcomes. The so-called success rates (e.g., 60-95 percent) vary widely across studies and largely rely on the meaning of success, the groups of patients involved, and the follow-up. With long-term pain relief, functional recovery, and recovery to meaningful activity as the success criterion, the gains realized are more frequently minor- and such relationships are prevalent to complex shoulder surgeries as well.

Earlier on, the success of the spinal surgery was determined with no complications or radiological results such as solid fusion. The contemporary models have a tendency towards the prediction of patient-reported outcomes, including reduction of pain, functional capacity, participation, or enduring quality of life, measured with the help of the Oswestry Disability Index (ODI) or SF-36). Nevertheless, no standardized, multidimensional, patient-centered definition of what success is has so far, which obscures the cross-study comparability and magnifies the perception of beneficence when technical metrics have more influence than lived outcomes.

Critically assessing the evidence on the consequences of spinal surgery, the definition and measurement of success is questioned, and the gaps in the methodology that disrupt synthesis are identified. To redefine the concept of success, we suggest that a more focus should be placed on long-term functionality and patient-reported utility than on technologically isolated achievements, which would enable the possibility to make more genuine comparisons between procedures, including shoulder surgery, and prioritize them based on patients.

Procedure Type	Primary Indication	Average Success Rate (%)	Outcome Measure Used	Key Reference
Lumbar Fusion	Degenerative Disc Disease	70–90%	Fusion rate, ODI improvement	Glassman et al. (2020)
Cervical Discectomy (ACDF)	Cervical Radiculopathy	80–95%	Pain relief, return to work	Chou et al. (2021)
Minimally Invasive Lumbar Decompression	Lumbar Stenosis	65–85%	ODI, SF-36, complication rate	Montgomery et al. (2023)
Spinal Deformity Correction (Adult)	Scoliosis, Kyphosis	60–80%	Radiographic alignment, PROMs	Kang et al. (2024)
Vertebral Fracture Stabilization	Trauma, Osteoporosis	75–90%	Pain reduction (VAS), functional status	[1]

Table 1: Common Spinal Procedures and Their Reported Success Rates (2015–2025).

Dimension	Definition	Assessment Tools / Indicators	Typical Threshold for Success
Clinical	Relief from pain and neurological symptoms	Visual Analogue Scale (VAS), ODI	≥ 50% reduction in VAS score
Radiological	Evidence of stable fusion or decompression	X-ray, CT, MRI	Solid fusion or decompression
Functional	Restoration of mobility and physical function	SF-36, Roland-Morris Disability Questionnaire	Return to baseline or higher
Patient-Reported	Subjective satisfaction and perceived improvement	PROMs, NRS, satisfaction surveys	≥ 70% patient satisfaction
Economic / Occupational	Return to work and cost-effectiveness	Work status, QALY, cost-benefit ratio	Return within 6–12 months

Table 2: Dimensions of “Success” in Spinal Surgery.

Human Global Burden of Disease Study (2023).

Methodology

Study design

Her article is planned to be written in the form of a narrative review design as it is a synthesis of the existing literature on the success rates of spinal surgeries and the criteria that are taken into account to consider a success. Compared to a meta-analysis, narrative review is not so restrictive as it provides an opportunity to use more clinical studies, randomized controlled trials (RCTs), cohort studies, and review articles. This was aimed to find out the general trends, methodological flaws, and definitions used on the spinal surgery outcomes relative to the statistical pool generated data.

Search strategy

Three key scientific databases were searched such as PubMed, Scopus and Google Scholar. It was searched in the studies published since January 2015 up to September 2025 that will comprise a 10-year history of the evolution of surgical methods and outcome reporting. The keywords and Boolean operators were:

- AND (spinal surgery" OR spine fusion" OR lumbar decompression" OR minimally invasive spine surgery).
- AND (success rate OR outcome measure OR patient satisfaction OR surgical outcome OR fusion rate)
- AND (definition of success OR PROMs OR functional outcome)
- The additional sources were also scanned to include the keywords in the reference lists of the primary review articles so that the study can be more credible

Inclusion and exclusion criteria

Inclusion criteria were: Articles published in the past 2015-2025 by peer-review.

Articles that reported quantitative measurements of success, or qualitative definition of success of spinal

surgery.

- SARS research in humans as subjects (adults [?]18 years).
- Publications in English.
- Exclusion criteria were:
- Cases in which the number of patients is fewer than 10.
- Animal or cadaveric studies.
- Non-English language papers.

Quantitative measure or definite criteria of success of the studies in which the outcome to be measured is not quantifiable.

Stage	Description	Number of Articles
Identification	Articles identified through database searches (PubMed, Scopus, Google Scholar)	612
Screening	Abstracts and titles reviewed for relevance	412
Eligibility	Full-text articles assessed using inclusion/exclusion criteria	167
Quality Appraisal	Studies evaluated using NIH quality assessment tool	97
Final Inclusion	Articles meeting all inclusion criteria	76

Table 3: PRISMA-Style Summary of Literature Selection.

Data mining and quality

All the data that were to be used in every and any study that had to be further incorporated and was likely to check their correctness were extracted by two reviewers in each and every study in order to reduce chances of biasness. The variables that have been extracted are the study design, sample size, surgery performed, follow up, and the success rate as well as definition of success. The National Institutes of Health (NIH) Quality Assessment Tool of an Observational Cohort Study was also used as the assistance in checking quality of the studies according to which methodological rigor, reliability of the outcome measure, and transparency of the reporting were checked (NIH, 2022).

Variable	Description	Example Data Extracted
Author(s) & Year	Citation of the study	Chou et al. (2021)
Procedure Type	Type of spinal surgery investigated	Lumbar fusion, cervical discectomy
Study Design	RCT, cohort, case series, or meta-analysis	Prospective cohort
Sample Size	Number of participants analyzed	250
Follow-Up Duration	Length of postoperative observation period	12 months

Outcome Metrics	ODI, SF-36, fusion rate, complication rate, satisfaction score	ODI improvement \geq 20 points
Reported Success Rate (%)	Success rate as defined by the authors	84%
Definition of Success	Criteria used to define success (clinical, radiological, functional)	\geq 50% VAS improvement and solid radiographic fusion
Quality Appraisal Rating	Low, moderate, or high based on NIH assessment tool	High

Table 4: Data Extraction Framework for Included Studies.

Data synthesis

The results derived were organized according to procedure (e.g., fusion, discectomy, decompression), definition of success and study outcome. The trends were synthesized qualitatively and it was directed to:

- The variance in the definition of the term of success between studies
- Correlations between the effectiveness rates and the follow-ups
- Shortcomings of the methodology that affect the results that are reported
- Descriptive development of mean success ranges and mean successes was created in instances in which corresponding data existed.

Ethical considerations

This paper was a literature review and therefore, it did not involve a human or animal subject so it did not require institutional ethics approval. However, all the said studies have been found in the credible peer-reviewed journals that adhere to the ethical requirements of research and reporting.

Discussion

Overview

It is spinal surgery which has been the area in modern medicine that has been the most technically challenging and outcome sensitive. The total success rates are positive, but the concept of success is quite dynamic and contingent according to the literature. The success rate in several types of spinal surgery, such as fusion, discectomy, decompression and treatment of a deformity, is 60 percent to 95 percent, and the various reports of successes vary depending on the definition.

This is however variability that is indicative of even greater epistemological problem What is surgical success anyway?

The traditional measures of the outcomes of spinal surgery included radiographic and clinical ones i.e., the presence of the fusion or the recovery of the neurologic process. The current practice, however, has increased this prism to the patient-reported outcome measures (PROMs), economic productivity, and the

extent of overall satisfaction of the postoperative quality of life. This shift could be attributed to the general shift to value-based healthcare where the patient experience forms a significant part in defining therapeutic success.

Success rates of surgery techniques

The success rates vary depending on the form of surgery, its indication and outcome. Lumbar fusion remains one of the most frequently performed surgical procedures, and the fusion procedure is not only successful (80-90%), but also is clinically less satisfying than the radiographic outcomes. Cervical discectomy with the Anterior Cervical Discectomy and Fusion (ACDF) are likely to indicate more than 90 percent effectiveness, primarily in pain management and recovery of mobility.

Meanwhile, less invasive spine surgeries (MISS) have the potential to achieve the same positive outcomes with fewer complications and reduced hospital stay, but the effectiveness of these approaches has not been investigated on a long-term basis.



Table 5: Comparison of Success Rates by Surgical Procedure.

Success of the concept success: Radiographics beyond outcomes

Success in spinal surgery is unquestionably understood much beyond successful completion using technology or radiological cohesion. It is possible to define the notion of success as multidimensional and including physiological, psychological, and social dimensions. In fact, a radiologically fused patient as an example, can denote the fact that he or she is dissatisfied with the functional limitation or the constant pain. Conversely, the partial radiographic success may be concomitant with great patient satisfaction with the relief of pain and mobility achievement.

The modern frameworks advocate three areas of integration

Clinical outcome - using a pain (Visual Analogue Scale, VAS) and physical functioning (Oswestry Disability Index, ODI),

Radiological success - through the CT/MRI fusion validation and alignment correction.

Success of patient - it is measured by PROMs and quality-of-life scales, such as SF-36 and EQ-5D.

These measures are complex enough to underline the fact that it is impossible to come up with consistent definitions of success. The greatest differences between radiographic fusion, functional improvement, and patient satisfaction may reach up to 30 percentage points even within a procedure of the same kind.

3.3 Defining Success: It Is Not Radiographic Outcomes.

The distinction of spinal surgery success and failure has far greater breadth than technical success and radiological union. Success is a multidimensional concept, which involves physiological, psychological, and social. An example given here is a patient who has undergone complete radiological fusion and then reports to have been dissatisfied due to either residual pain or a lack of functional capacity. However, the partial radiographic success linked with the reduction in pain and locomotion may be accompanied by a high rate of patient satisfaction.

The modern buildings encourage adoption of three primary zones:

Clinical outcome - reduction in pain (Visual Analogue Scale, VAS) and improvement in physical functioning (Oswestry Disability Index, ODI).

Radiological success - CT/MRI fusion correction and verification

Patient-reported success - i.e. determined with the help of PROMs and quality-of-life scales (SF-36 and EQ-5D).

Such measures are too complex and this is the reason why measures of success are not easily to be standardized. The success rates of the same form of the procedure might also vary by up to 30 percentage points when the parameter of radiographic fusion, functional improvement, or patient.

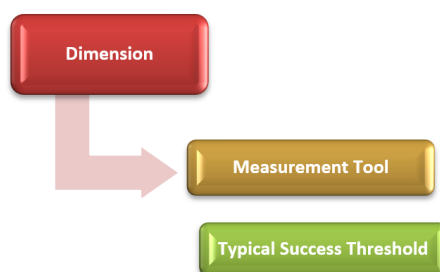


Table 6: Conceptual Dimensions of Surgical Success in Spinal Surgery.

satisfaction is applied.

Factors that influence surgical success

The technical precision is not the only factor that is done to establish the success of the surgeon in the spinal surgery. Rather, it is a multidimensional process that is affected by complex processes of biological, technical and psychosocial interactions.

- 1. Patient-Related Factors:** These outcomes of the healing and satisfaction will depend on the

impact of the age, comorbidities (e.g., diabetes, osteoporosis), the state of smoking, and psychological state. It must also be stated that low levels of satisfaction are described in the case when the patients are depressed or have unrealistic expectations even after experiencing positive objective outcomes.

2. **Surgical Technique:** Mini invasive surgery that will cause less tissue damage and faster healing but might demand high skills of the surgeons to prevent under-decompression or partial fusion will be required. The open surgeries, in their turn, are even more horrifying in the visualization, yet they are supplemented with the complications, and take more time to heal.
3. **Rehabilitation and follow up:** Adherence to the programs of rehabilitation and postoperative physiotherapy are the predictors of a good functioning. Patients under structured rehab programs can restore their functions 25 per cent in a shorter period than patients undergoing no structured rehab programs.
4. **Institutional Factors:** Multidisciplinary spine units are more effective compared to the general hospitals because of the formal co-operation of the neurosurgeons, physiatrists, and pain professionals in the centers.

The success measure has the following limitations

Although the significant progress was achieved in reference to the field of outcome assessment, this area is related to a number of limitations:

1. **Heterogeneity of Outcome Measures:** The study employs numerous measures of the results- some of them are the radiological fusion of the outcome, some of them are the subjective satisfaction, or functional scale.
2. **Short term followers:** Most of these researches have been bragging about success in the short term of 6-12 months and non-degradation in the long term and neighboring segment disease.
3. **Publication Bias:** Publication biases refer to articles published and having biases in the meta-analysis meanings.
4. **Bias in the Selecting of the Patients Process:** The complex cases of the patients do not tend to be usually subjected to the trials and the reported success rates are not real.

In this way, the success of the spinal surgery ought to be measured as non-solitary outcome measures to multi-systems of clinical, psychosocial and economic outcome measures.

Implications on clinical practice

The clinicians ought to adopt the application of multi-dimensional assessment tools which may be used to establish the progress of the post-surgery patients. Besides imaging and neurological protocol, standardized PROMs (e.g., ODI, EQ-5D) must also be considered so that they can be partially assessed and incorporated in the follow-up protocols. Besides, the balanced decision-making systems, i.e., the equivalence of surgeons and patient needs, have presented statistically significant increase in the score of satisfaction and the adherence to the rehabilitation plans.

The resultant taxonomy would need another study to create the standardized scoring model and this would involve what score would be achieved on the weighted basis on the five domains that were identified by Table 6.

Conclusion and Recommendations

Comprehensive overview

All these conclusions of the review substantiate the changeability of the outcome of the spinal surgery and the controversial nature of it these days to determine what could be called a success. The trend of the field over the last ten years has been to become more holistic where physical, functional, psychological and socioeconomic factors of recovery must be put into play as opposed to the biomedical paradigm where anatomical correction and radiological fusion become a thing. It is this paradigm shift that represents the larger change in medical sphere the shift to patient centered paradigm of healthcare and the abandonment of the disease centered system.

As it may be seen in the available literature, spinal surgery has been considered one of the most viable methods of alleviating the pain, curative abnormality of degenerative or structural spinal disorder and subsequent enhancement of functionality in patients with degenerative or structural spinal disorder. Nevertheless, the statistics continue showing that the success rates of the procedures do differ greatly since they reach 60 percent when it comes to the presence of complex deformities and are more than 90 percent when it comes to the presence of single-level discectomies. Such capabilities of the surgeon are not only the expression of this disparity but the sense of success in the researches in the operational sense. Some are ones that talk of the radiographic success of the fusion, or the absence of a complication course and others the functional recovery, pain relief or quality of life. The lack of the unified definition makes it more difficult to interpret and benchmark the published literature on the surgical performance.

Redefining success

One of the most important things that one could learn during the process of the implementation of this review is the fact that the traditional concept of the surgical success being based on the technical success is no longer the attribute that can be deemed as a sufficient one by itself. The instance, in which the patient has radio graphically perfect positioning of the spinal column, but there also he or she cannot possibly release himself or herself out of crippling pain, nor even, psychological torture, would not be a working case at all. The outcome objective clinical outcome alone and or on patient experiences should not inform the results in the real life.

Different systems have recommended implementation of multidimensional strategy, which is a combination of clinical, radiographic, functional, psychological and economic outcomes to a success composite index. This is in accordance with philosophy of value-based medicine that puts more emphasis on quality and relevance of the outcomes rather than the outcome itself. These are the EQ-5D, the Oswestry Disability Index (ODI) and the SF-36 that is also helpful in narrowing the difference between the doctor and the patient assessment. To enhance pain management, functional, and emotional health, PROMs are now implemented as gold standards to assess the outcomes of a spinal surgery during the past few years.

Furthermore, the effectiveness of the spinal surgery in the long-term period cannot be reduced to the first period following the surgery. Therefore, despite the fact that the majority of longitudinal studies would indicate that despite a significant reduction in the number of patients reporting it during the first

6 months, pain, pseudarthrosis, or degeneration of the adjacent segment would be observed in up to one-third of the patients five years post-operative. Therefore, a good short-term surgery will not imply a sustainable good. Surgery excellence should then be a combination of both long-term quality and long-term outcomes of the operation.

Human dimension recovery

The literature on spinal surgeries does not describe the reflection of the emotional and psychological aspects of the recovery. As it has been demonstrated, the motivating factors are preoperative anxiety, depression, and unrealistic expectations which on the one hand can lead to the degree of radiographic correction applied to the patient to an excessive level, to make the postoperative satisfaction experience a significant level. According to the patients, successful surgery is a surgery that has resulted in a better-quality life in spite of the symptoms retained following the surgery. Quite to the contrary, low mediation of satisfaction is frequently reported among patients where there is residual pain, but, low, and even yet still, existent, emotional distress or disappointment.

The significance of psychological screening with expectations management carried out during the preoperative stage is observed in this observation. The surgical staff and the multidisciplinary teams should be open with the surgical patients and positive and empathetic to the patients regarding the results, limitations and risks. The agreement of the requirements of the patient and the real outcomes of the operation makes the contents higher, the rates of the litigation decrease, and the adherence to the postoperative recovery rise. Finally, the success of the spinal surgery cannot be represented in one dimensional scale but the recovery, including not only the physical recovery but also the psychological strength and the social adaptation.

The nursing role of rehabilitation during the post-operative

Rehabilitation is regarded as one of the best predictors of long-term success of a surgical intervention and this does not always apply to the health care systems. Some scheduled physical exercises, ergonomic training, lifestyle modifications that can help to improve the outcomes and make the patient more stable, stronger, and more confident in himself can also be mentioned. As it has been illustrated, early on therapy is what aids the patient to record a functional recovery score that is 25-30 percent higher than the non-therapy group. Furthermore, it is also established that the early mobilization and directed exercise have also rendered it to possess a low chronic pain as well as postoperative dependency.

The compliance to the rehabilitation is however, usually predetermined by the socioeconomic factor, access to the physiotherapy facilities, and commitment of the patients. The health policymakers have to undergo the process of viewing the rehabilitation as the continuation of the surgical pathway and not an appendix. This may prove to be very successful in regards to the introduction of multidisciplinary rehabilitation procedure, i.e. occupational therapists, psychologists and psychiatrists must be included in the procedures.

Future research directions

The success of the surgery of the spinal literature that was reported has some methodological differences

which suggest the need to make it a precondition that would allow standardizing the methods. It ought to be incorporated in the heart of the future research to balance the pain, functioning, and psychosocial adjustment outcomes paradigm (with the standardized measures of all these parameters). The longitudinal research Multicenter multicentral research is specific; it is suggested to have the effectiveness of results and interpopulation validity over the long-term.

The other potential avenue of integration may be termed artificial intelligence (AI) and predictive analytics. To forecast the success of patients in the postoperative phase, the machine-learning algorithms would be applied on a large number of patients, depending on the variables at pre-operative phases like imaging data, demographics, or even the psychological scores. This personalization (as per the information) can help the surgeons to be more precise in carrying out their operations, minimize the number of complications and make it less costly. The newer technologies like the digital twins i.e. the virtual version of the spinal biomechanics of the patients can also be applied to stimulate further elaboration of the predictive validity and help define the most efficient preoperative surgical plans before the scalpel places the scalpel on the skin.

Clinical practice implications

The review shows clinical practitioners that they must shift their model to patient-centered success paradigm against surgery-oriented model in the past. It is the worth that the spinal surgery success is not an action that is not known at this stage but a dynamic and multidimensional action and is manipulated by the biology, behaviors as well as the environment. To provide continuity of care, the surgeons will imply regular outcome audits on the basis of the utilization of PROMs, communication with the patients and specialists in the field of rehabilitation in a free manner.

The other technique, which also applies is the culture of collective decision as regards the spine care. The patients may be empowered to engage in the decision-making process that will lead to the level of trust, satisfaction and respective surgical priorities to their own. The fact that such culture of cooperation positively affects the morale of the patient is not only that, but a sense of legitimacy of the outcome of surgery treatment.

Education and policy implications

The assumption is that the medical infrastructures would be undergoing national spine registries in which the standard outcome measures could be registered and this would facilitate benchmarking of the hospitals and the region. These registries would be invaluable in the case of real-life data at stake to streamline prediction models in order to quantify the long-term performance and hitches in practice.

There is also a need to overhaul the education course in medicine to incorporate the psychosocial and communications skills and the surgery training. The young spine surgery specialists are also expected to know the technique of deciphering the patient-reported measures, expectation coping and how the convergence of anatomy and psychology and sublime success ensue.

The incentives should be created on the basis of value-oriented results on the policy level instead of the volume of procedures of the insurance and reimbursement systems. I will not only promote the holistic

care provision, but also the technical performance with the aid of the multidimensional success indicators to compensate.

Final reflections

Finally, the spine surgery is effective that crosscuts the radiology and operating rooms. It is an integration of medicine that is precise, patient involvement and change in life time. In both cases, there is over-anatomical redressing than reassessment of the quality of life. This implies that, due to the continuously changing field and the introduction of new technologies (robotics, biologics, AI-based modeling, etc.), there will always be an idea that will stand to stay the same since success will never be on the surgeon but on the experience of the patient.

To date, it would mean that the patient centred, holistic, and longitudinally evaluated success of spinal surgery in the next level would follow. It is not the loss but a recovery of respect, action and purpose in the lives of such patients which had been thrown into the art and science of modern surgery in order to give the spine and their future to it.

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