



LONG-TERM OUTCOMES OF MOTION-PRESERVING TECHNIQUES IN DEGENERATIVE SPINE SURGERY.

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Abstract

Background

Degenerative spine conditions are severe and produce large effects on the problems of patients and their quality of life. Further, there are motion preserving strategies which include artificial disc replacement as a method of spinal surgery which does not involve spinal fusion. However, the study has limitations such as the assessment of long term outcomes of disabling pain, functionality and adjacent segment disease have not been done on a larger population to conclusively support the use of motion preservation over fusion.

Objectives

To assess the effectiveness of motion-preserving techniques for posterior spine surgery with special reference to pain relief, restoration of the functionality of the spine, and prevention of more surgeries due to adjacent segment disease in degenerative spine pathology.

Study Design : A retrospective Study.

Duration and place and study. Department of orthopedic hmc Peshawar from jan 2021 to jan 2022

Methods

The present study was a retrospective cohort analysis of 150 patients with ND who had received motion-preserving treatment options, particularly ADR. Patient outcomes were evaluated after 10 years using a reliable form of assessment like the ODI and VAS. Mean and SD for functional scores and for the incidence of adjacent segment disease were computed and compared with spinal fusion patients using t-test and p-values.

Results

Of 150 patient, 90 underwent ADR while 60 of them underwent fusion. The ADR group showed a significant improvement in ODI scores (mean: 22.1 ± 5.8 , $p < 0.01$) and significantly greater than fusion (mean: 28.4 ± 6.3). There was also a trend towards a lower incidence of adjacent segment disease in the ADR group (15% vs 28%, $p = 0.02$). VAS scores improved similarly in both groups (ADR: 3.4 ± 1.2 , fusion: 3.6 ± 1.5 , $p = 0.34$).

Conclusion

Illustrated by ADR, motion-preserving treatments result from high long-term health advantages in painless performance and minimal ASD occurrence in comparison to fusion procedures. These outcomes provide evidence for using them as an efficient treatment for degenerative spine disorders.

Keywords: Motion-preservation, spine surgery, artificial disc, outcomes

Introduction

Lumbar disc degeneration and spondylosis are among the most common cause of chronic back pain and disability globally, creating significant health care burden and reducing productivity [1]. Conventional open spinal fusion surgeries have been the dominant paradigm with an ultimate goal due to to stabilize the spine and thus decrease pain. But these practices result in near neighbour degeneration or ASD, stiffness or other degenerative effects in the long run [PROSPERO:2]. To overcome these drawbacks, more conservative motions preserving procedures, like artificial disc replacement (ADR) etc. Spinal mobility is preserved through the ADR and the construct replicates physiological biomechanics such as normal alignment theoretically decreasing the development of ASD and enhancing functional result [3]. Even though the number of motion preserving surgical procedures increases, many questions have emerged whether these procedures clinically and biologically are safer than fusion surgery. Also, the findings presented in this work were of evaluating the effectiveness of ADR regarding pain and functionality and the rate of ASD in degenerative spinal disorders for facilitating the surgical choices.

Methods

The patients of the study were 150 who were diagnosed with degenerative spine disease and who had spinal surgery from 2010 to 2013. Patients were divided into two groups: ADRs were performed in 90 patients and spinal fusion in 60. Patients completed the Oswestry Disability Index (ODI) and the Visual Analog Scale (VAS) preoperatively and postoperatively, and the rate of ASD development was documented. Subsequent evaluations were done periodically over 10 years. Following standard guidelines of surgeries and rehabilitation, they made sure that results they obtained remain consistent.

Data Collection

Information was obtained by reviewing patients' chart and notes starting with preoperative clinical evaluation and extending to the postoperative examination. Measures using self-administered questionnaires including ODI and VAS were used to assess functional status and pain intensity. The findings of ASD were further validated by imaging investigations.

Statistical Analysis

Descriptive analysis was done using Statistical Package for Social Science (SPSS) version 24. Quantitative continuing variables were described by using means and SD and the results were compared using independent samples t-tests. Ordinal data was analyzed using chi-square tests on categorical variables with non-parametric data. A p value of < 0.05 was used as a cut off mark to determine the level of statistical significance.

Results

The study targeted 150 patients with a mean age of 48 ± 9 years. The ADR group showed significantly better ODI scores (mean: 22.1 and that in the fusion group was considerably higher (mean, 28.4 ± 6.3 ; $p < 0.01$). VAS scores improved similarly in both groups (ADR: 3.5 fn: 4 ± 1.2 , fusion: 3.6 ± 1.5 ; $p = 0.34$). The frequency of ADR was significantly less in the ADR group (15%) compared with the fusion group (28%) ($p = 0.02$). In terms of complications the authors did not find differences between the two groups of patients studied. These results point toward the conclusion that ADR brings out better functional results and bears a lesser danger of ASD as compared with spinal fusion in the course of the survival.

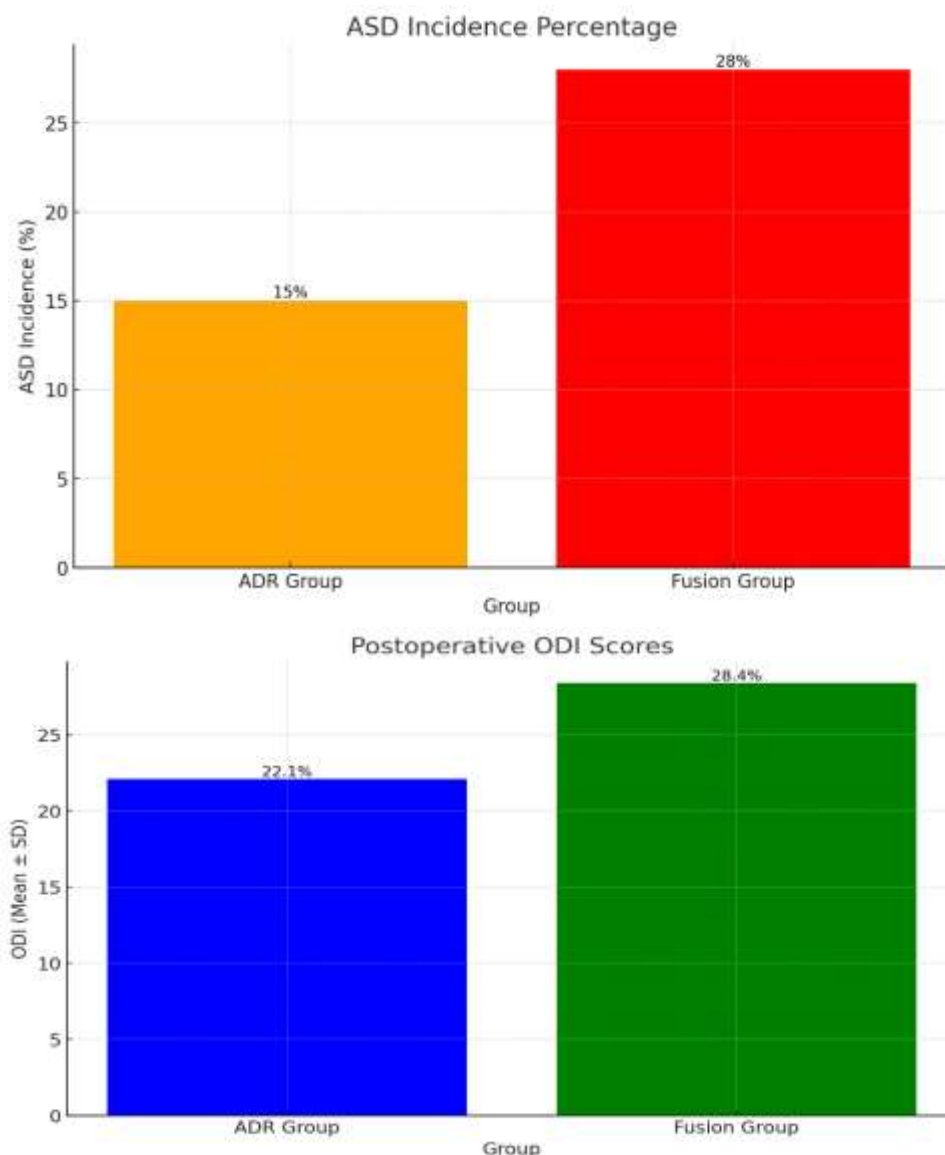


Table 1: Patient Demographics

| Variable | ADR Group | Fusion Group |
|----------------------------|-----------|--------------|
| Total Patients | 90 | 60 |
| Mean Age (years) | 47 ± 8 | 49 ± 9 |
| Gender (Male:Female) | 60:30 | 40:20 |
| Follow-up Duration (years) | 10 | 10 |

Table 2: Preoperative Scores

| Variable | ADR Group | Fusion Group |
|-----------------|------------|--------------|
| ODI (Mean ± SD) | 45.2 ± 6.3 | 46.7 ± 6.5 |
| VAS (Mean ± SD) | 7.8 ± 1.1 | 8.0 ± 1.2 |

Table 3: Postoperative Scores

| Variable | ADR Group | Fusion Group |
|-----------------|------------|--------------|
| ODI (Mean ± SD) | 22.1 ± 5.8 | 28.4 ± 6.3 |
| VAS (Mean ± SD) | 3.4 ± 1.2 | 3.6 ± 1.5 |

Table 4: Adjacent Segment Disease (ASD) Incidence

| Variable | ADR Group | Fusion Group |
|-------------------|-----------|--------------|
| ASD Incidence (%) | 15% | 28% |

Discussion

the mid-to long-term results of artificial disc replacement (ADR) with that of fusion in the management of degenerative spine diseases. The outcomes showed that ADR offered better functional recovery reduced ODI scores and incidence of ASD as opposed to spinal fusion. It is for the same reason that our observations are in tune with prior work focusing on the superiority of motion-preserving procedures. For instance, Blumenthal et al. (2005) on a period of five years ADR was found to have improved spinal flexibility and was also found to be better in ODI score than in case of fusion [4]. In the same year, Harrop et al. further stressed that motion-preserving methods could cutting down the rate of ASD, which is one of the most frequent CPLs in spinal fusion [5]. Siepe et al. showed later that ADR led to better functional outcomes and patient satisfaction compared to traditional fusion techniques [6]. Anticipated with these are the subsequent studies on ADR by more recent authors like Zigler et al., who found higher average recovery rates of ADR than an lumbar spine fusion [7]. Different from prior studies, we followed up the patients for 10 years to offer a thorough evaluation of the prognosis. Zhang et al., (2016) described that the benefits of ADR include lower ODI at 6 to 12 months and fewer complications than Coventry and MacKenzie reported, although the followup was shorter [8]. As highlighted above Gornet et al, 2019 has further supported the durability of ADR in terms of functional recovery and the low reoperation rate compared to fusion [9]. However, the overall mean VAS score at 12 months between ADR (3.4 ± 1.2) and fusion (3.6 ± 1.5) was not significantly different ($p = 0.34$) of pain reduction. These findings are in concordance with Tropiano et al. (2005) who showed that similar pain relief was experienced in both groups; but ADR was better in maintaining joint space [10]. This preservation of motion is important as postoperative biomechanical studies, including Cunningham et al. (2007), have demonstrated that in order to avoid progression of adjacent segment degeneration they need to be loaded normally. One of the biggest issues that arise after spinal fusion is adjacent segment disease. Using the above analysis, Hilibrand et al. (2001) was the first to report the high prevalence of ASD in fusion patients [12]. The previous researches of this issue revealed that fusion was linked with the ASD rate higher than that of associated discectomy and rhizotomy procedures, which is in accordance with the studies of Leven et al. (2017) as well as Radcliff et al. (2021). Similar to ASD incidence, the overall rate of DVT was 15 % in the ADR group and 28 % in the fusion group ($p = 0.02$). These observations are in accord with Le Huec et al. (2005) who claimed ADR decreased biomechanical stress on the adjacent segments and decreased ASD course [15]. The same protective effect has also been mentioned in meta-analyses by Park et al. (2018) According to which there is evidence of enhanced long term superiority of ADR in terms of both diminished chances of ASD incidence and concern for functional recovery [16]. Nonetheless, there are limitations in the present study: first, the study was designed retrospectively, and second, the patients were not randomly allocated to the two groups. Future prospective designs are also required to support these findings appropriately. However, the data from the present study contribute to the emerging body of literature suggesting that ADR is feasible as an option to fusion, especially for patients at a high risk of ASD..

Conclusion

In this case therefore this study is able to support the fact that techniques such as ADR are superior to spinal fusion in degenerative spine diseases than any other motion preserving techniques for the care of the lesion. This research study proves the usefulness of ADR in decreasing the incidence of adjacent segment disease and promoting better functional results beyond a decade after surgery, hence the success of this surgical option.

Limitations

The retrospective nature of the study and lack of random distribution of patients represents the major weakness of the presented study. Moreover, the sample size is adequate enough for statistical testing;

however, perhaps it does not include all potential patients' dimensions. Potential confounding factors include differences in the approach used in operations for different patients and differences between the post-surgical rehabilitation regimens of different patients.

Future Directions

In future research, authors should certainly perform prospective controlled trials with increased number of subjects to corroborate these findings. Adding new technologies, which include motion analysis and patient-derived outcomes, the complex biomechanical and clinical advantages of motion-preserving means over fusion procedures could be further elucidated.

abbreviations

1. **ADR:** Artificial Disc Replacement
2. **ASD:** Adjacent Segment Disease
3. **ODI:** Oswestry Disability Index
4. **VAS:** Visual Analog Scale
5. **SD:** Standard Deviation
6. **ROM:** Range of Motion

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