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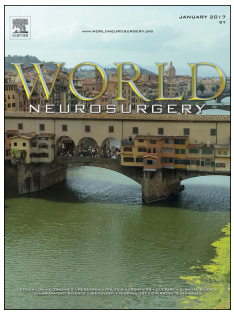

Sexual Dysfunction Secondary to Lumbar Stiffness in Adult Spinal Deformity Patients before and after Long-Segment Spinal Fusion

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Title: Sexual Dysfunction Secondary to Lumbar Stiffness in Adult Spinal Deformity Patients before and after Long-Segment Spinal Fusion

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Institutional Review Board Approval was obtained at all participating institutions for collection and analysis of patient data.

Key Words: Adult spinal deformity, sexual function, stiffness, lumbar stiffness disability index, spinal fusion

Abstract

Object: Sexual function is an important factor which contributes to quality of life. ASD patients may have sexual limitations due to lumbar spinal stiffness which may be affected by long-segment fusion.

Methods: This study utilized a multi-center, prospectively defined, consecutive cohort of ASD patients. The primary outcome in this study was the LSDI question 10: "Choose the statement that best describes the effect of low back stiffness on your ability to engage in sexual intercourse".

Results: In total, 368 patients were included in this study, including 76 males and 292 females of which 80.7% (n=293) underwent 9 or more level fusion and 74.4% (n=270) had pelvic fixation. Baseline LSDI sexual function scores averaged 1.7 (SD 1.3), which improved to 1.3 (SD 1.2) at 2-year follow-up ($p = 0.0008$). After adjusting for confounding factors, worse LSDI sexual function score was strongly associated with worse ODI, SRS total, and SF-36 PCS and MCS scores at both baseline and 2-year follow-up ($p<0.05$ for all comparisons). Predictors of poorer baseline sexual function included older age, increased SVA, and increased back pain ($p<0.05$ for all comparisons). Predictors of improvement in sexual function at 2-year follow-up included SVA improvement ($p=0.0032$) and decreased postoperative back pain ($p<0.0001$).

Conclusions: This study found that sexual dysfunction scores due to lumbar stiffness significantly improved following surgery for ASD. Additionally, lumbar stiffness related sexual dysfunction is strongly related to overall outcome measured by ODI and SRS total score, highlighting the importance of sexual health on overall outcome in ASD patients.

Key Words: Adult spinal deformity, sexual function, stiffness, lumbar stiffness disability index, spinal fusion

Introduction

The primary goal for successful surgical correction of adult spinal deformity (ASD) is improvement in health-related quality of life (HRQOL). While ASD surgery has been shown to result in improved radiographic parameters and HRQOL measures in well-selected patients,[1–7] most investigations have focused on composite HRQOL measures when evaluating clinical outcomes rather than specific outcomes such as sexual function.

Although uncommonly assessed during patient visits[8,9], sexual function plays an important role in patients' self-reported quality of life[10]. Back pain has been associated with decreased sexual activity in both men and women,[11] with 55% of men and 84% of women noting sexual problems after the onset of low back pain in one recent study.[12] While surgical treatment of single-level lumbar disc herniations has been found to improve patients' sexual function[12,13], a recent study noted worsened sexual function in 39% of patients following cervical spine surgery with only 5% of patients reporting improved function.[14]

Hamilton et. al.[15] evaluated post-operative sexual function in 62 consecutive ASD patients and noted a 42% incidence of severe sexual dysfunction postoperatively. However, for many of these patients, the poor sexual function was attributable to lack of a sexual partner. Furthermore, nearly 40% of patients assessed reported no or only mild sexual dysfunction despite a mean age of 70 and extensive spinopelvic instrumentation. Importantly, no preoperative evaluation of sexual function was performed for comparison. Thus, the effect of surgery for ASD on patient sexual function remains unclear. This study aims to evaluate the effect of long-segment fusion for ASD on lumbar stiffness-related sexual dysfunction and hypothesized that surgery would increase stiffness-related sexual dysfunction.

Methods

Patient Population

A retrospective review of a prospectively collected multicenter database of ASD patients in the United States was performed. Institutional review board approval at all participating institutions was obtained prior to patient enrollment. Inclusion criteria for database enrollment included age ≥ 18 years old with diagnosis of adult degenerative or idiopathic scoliosis. Patients were required to meet at least one of the following radiographic parameters; coronal Cobb angle ≥ 20 degrees, sagittal vertical axis (SVA) ≥ 5cm, pelvic tilt (PT) ≥ 25 degrees, or thoracic kyphosis (TK) ≥ 60 degrees. Patients with spinal deformity secondary to causes other than degenerative or idiopathic, including traumatic, neuromuscular, congenital, infectious, and paralytic, were excluded. Patients with less than 2 years of follow-up were excluded from analysis.

Data Collection

Demographic and clinical data was collected on all patients, including age, gender, body mass index (BMI), ASA score, Charleston Comorbidity Index (CCI), history of prior surgical intervention, pelvic fixation, number of levels fused, and postoperative revision. Baseline and 2-year follow-up radiographic parameters including sagittal vertical axis (SVA), pelvic tilt (PT), pelvic incidence (PI), and maximum Cobb angle were collected. Additionally, health related quality of life (HRQOL) scores, including Lumbar Stiffness Disability Index (LSDI), Oswestry Disability Index (ODI), SF-36 Physical Component Summary (PCS) and Mental Component Summary (MCS), Scoliosis Research Society-22r (SRS) scores, and back pain numeric scale rating (NSR), were recorded at baseline and 2-year follow up. Question 10 from the Lumbar Stiffness Disability Index (LSDI) survey was selected as the primary outcome measure. This

question read “Choose the statement that best describes the effect of low back stiffness on your ability to engage in sexual intercourse”. Patients responded on a scale from 0 to 4, with 0 representing “no effect at all” and 4 representing “cannot do at all” (Table 1).

Statistical Analysis

The Wilcoxon-Mann-Whitney test was utilized to assess for difference in HRQOL between baseline and 2-year follow-up. Multivariate linear regression was used to determine factors associated with poor sexual function at baseline and change in function from baseline at 2 years postoperatively. Further, multiple linear regression analysis was utilized to assess for association between self-reported sexual function and HRQOL measures at baseline and 2-year follow-up, while adjusting for all factors previously included in analyses of baseline sexual function. As the LSDI is calculated from component questions via numerical summation of responses, patient answers to question 10 regarding sexual function were considered both ordinal and interval data. Statistical significance was set *a priori* at $p<0.05$. All statistical analysis was performed using SAS 9.4 (SAS Institute, Cary, NC).

Funding

This study was funded by the International Spine Study Group Foundation (ISSGF).

Results

Patient Characteristics

A total of 368 patients, including 292 (79.4%) female patients and 76 (20.7%) male patients, met inclusion criteria (Table 1). 254 (69.0%) patients were age 40-69, with 63 (17.1%) under 40 and

51 (13.9%) over 70. Body mass index (BMI) was evenly distributed among patients, with BMI < 25 (125, 34.0%), BMI 25-29 (137, 37.2%), and BMI>30 (106, 28.8%). 229 (62.2%) of patients had a Charlson Comorbidity Index (CCI) score of 0 or 1 versus 139 (37.7%) of patients with a score of 2 or greater. Similarly, ASA grade was I or II for 222 (63.6%) patients versus III or IV for 127 (36.4%) patients. 126 (34.2%) patients had a history of prior spine surgery. Overall, 48.5% (176) patients had 11 or greater levels fused, 80.7% (293) had 9 or greater levels fusion, and 74.4% (270) underwent pelvic fixation. Baseline radiographic parameters and SRS-Schwab curve classification are described (Tables 2 and 3).

Sexual Function and Health-Related Quality of Life Changes; Baseline Versus 2-Year Follow Up

LSDI sexual function scores improved from a mean of 1.7 (SD 1.3) at baseline to a mean of 1.3 (SD 1.2) at 2-year follow-up ($p = 0.0008$), Table 2. Similar improvements in ODI (42.6 to 27.0, $p<0.0001$), PCS (32.7 to 40.8, $p<0.0001$), MCS (45.3 to 49.3, $p<0.0001$) and SRS (2.8 to 3.7, $p<0.0001$) were observed at 2 year post-operative follow up (Table 3).

Predictors of Baseline and 2-Year Change in Sexual Function

Upon multivariate linear regression analysis, significant predictors of lower baseline sexual function included older age (40-59 vs. <40 [β 1.06, $p=0.0003$], 60-69 vs. <40 [β 1.50, $p<0.0001$]. ≥70 vs. <40 [β 1.53, $p=0.0028$]), increased SVA (β 0.007 per millimeter, $p=0.0214$), and increased back pain NSR (β 0.208 per unit, $p<0.0001$). There was no significant association between baseline sexual function and gender, BMI, CCI, previous fusion, or other baseline radiographic parameters (all $p>0.05$). (Table 4) At 2-year follow-up, the only significant predictors of change in sexual function from baseline were change in SVA from baseline (β 0.004 per millimeter, $p=0.0032$) and back pain NSR (β 0.126 per unit, $p<0.0001$). (Table 5)

Sexual Function as a Predictor of Health-Related Quality of Life

After adjusting for confounding variables, a strong association between the LSDI sexual function score and all HRQOL measures was noted at both baseline and 2-year follow-up time points. Specifically, poor sexual function (response of 2/3/4 to LSDI question 10) was associated with worse ODI, SRS, PCS, and MCS score at baseline and at 2-year follow-up ($p<0.05$ for all comparisons).

Discussion

This investigation assessed the effect of long segment ASD surgery on lumbar stiffness-related sexual function. The LSDI sexual function score measures the degree to which patients are unable to participate in sexual activity due to their low back pain. Prior to surgical intervention, the mean LSDI sexual function score was 1.7, which improved to a mean of 1.3 at the 2-year postoperative period. A score of 2 on the LSDI scale represents a "Significant Effect", while a 1 represents a "Minor Effect". While this decrease was relatively small in magnitude, it is surprising that stiffness-related dysfunction did not increase following long-segment spinal fusion.

While the literature on sexual function following surgery for adult spinal deformity is limited, recent investigations have evaluated sexual function measures before and after lumbar discectomy and cervical spine surgery. In an evaluation of 43 patients following surgery for lumbar disc herniation, Akbas et. al. found that despite no change in levels of sexual desire, the frequency of intercourse increased and the description of any type of sexual problem decreased significantly.[12] Similarly, Elsharkawy et. al., in a study of 114 patients undergoing surgery for single level lumbar disc herniation, the authors concluded that lumbar disc surgery had a positive

effect on sexual function.[13] However, it should be noted that the large majority of patients (69.3%) in this patient cohort rated their sexual function following surgery the same as pre-surgical function, compared to 16.7% who noted an improvement in sexual function. Furthermore, 14.0% of patients in this study rated their sexual function worse following surgery. Keefe. et. al., in a recent study of sexual function following cervical spine surgery, noted substantial difficulty in the postoperative period, with 39% of patients reporting worsened sexual function, compared to only 5% of patients reporting improvement.[14]

The results of this investigation will be useful when counseling patients about the outcomes of surgery for ASD. Although patients do not often feel comfortable asking their doctor questions about sexual activity,[9] sexual function is closely tied to overall quality of life.[10] Educating patients pre-operatively that surgery for ASD is associated with a statistically significant improvement in sexual function will make them feel more confident in the surgery and answer a question that they may be too embarrassed to ask.

Baseline elevated SVA and back pain were independently correlated with stiffness-related sexual dysfunction, and similarly improvement in these 2 factors were correlated with improvement in sexual limitations due to stiffness. These results help to elucidate the etiology of sexual limitations in ASD patients and will aid in prediction of who will enjoy improvement of lumbar stiffness related sexual dysfunction after ASD surgery.

This study has several potential limitations, including its retrospective nature, which limits our conclusions to correlation instead of causation. An additional weakness of the study in the clinical significance of the stiffness-related sexual dysfunction improvement: although there is a statistically significant difference in 1.7 and 1.3, both averages fall between the categories of

"minor" and "significant" effect on ability to engage in sexual intercourse. The responses to the question are not nuanced enough to delineate what this difference translates to in the real-world setting, which could be a topic of further research.

Conclusion

This study found that sexual dysfunction scores due to lumbar stiffness significantly improved following surgery for ASD. The small increase in measured sexual improvement may not equate to meaningful clinical improvement, however the fact that sexual function scores related to stiffness after long-segment spinal fusion improved is an important component of pre-operative counseling. Back pain and sagittal malalignment were particularly associated with baseline (and improvement) in sexual function. Additionally, lumbar stiffness related sexual dysfunction is strongly related to overall outcome measured by ODI and SRS total score, highlighting the importance of sexual health on overall outcome in ASD patients.

Table/Figure Legend

Table 1: LSDI Sexual Function (Question 10)

Table 2: Descriptive Statistics (Categorical Variables)

Table 3: Descriptive Statistics (Continuous Variables)

Table 4: Predictors of Baseline Sexual Function

Table 5: Predictors of 2-Year Change From Baseline Sexual Function

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Table 1: LSDI Sexual Function (Question 10)

Choose the statement that best describes the effect of low back stiffness on your ability to: (10) Engage in sexual intercourse	
0	No effect at all
1	Minor effect
2	Significant effect
3	Require assistance
4	Cannot do at all

Table 2: Descriptive Statistics (Categorical Variables)

Variable	N	%
All Patients	368	-
Age		
<40	63	17.1
40-59	145	39.4
60-69	109	29.6
>70	51	13.9
Gender		
Male	76	20.7
Female	292	79.4
Baseline		
BMI		
<25	125	34.0
25-29	137	37.2
>30	106	28.8
Charlson		
0	145	39.4
1	84	22.8
2	64	17.4
3+	75	20.4
Prior Spine Surgery		
No	242	65.8
Yes	126	34.2
ASA		
Grade I/II	222	63.6
Grade III/IV	127	36.4
Missing = 19		
Pelvic Fixation		
No	93	25.6
Yes	270	74.4
Missing = 5		
Postoperative Revision		
No	319	86.7
Yes	49	13.3
Levels Fused		
≤8	70	19.3
9-10	117	32.2
11-15	81	22.3
≥16	95	26.2
LSDI Sexual Function		
0	78	21.2
1	111	30.2
2	92	25.0
3	26	7.1
4	61	16.6

Table 3: Descriptive Statistics (Continuous Variables)

Variable	Mean	SD
Baseline		
HRQOL		
LSDI Sexual Function	1.7	1.3
Back Pain NSR	7.0	2.3
ODI	42.6	19.3
SF-36 PCS	32.7	10.5
SF-36 MCS	45.3	13.9
SRS Total	2.8	0.8
Alignment		
Pelvic Tilt	22.9	11.2
Pelvic Incidence	55.1	12.8
SVA	57.1	75.1
Maximum Cobb Angle	42.7	20.5
2-Year Follow-up		
HRQOL		
LSDI Sexual Function	1.3	1.2
Back Pain NSR	3.7	3.1
ODI	27.0	20.8
SF-36 PCS	40.8	11.6
SF-36 MCS	49.3	12.4
SRS Total	3.7	0.9
Alignment		
Pelvic Tilt	20.5	10.2
Pelvic Incidence	54.8	12.8
SVA	26.6	55.7
Maximum Cobb Angle	23.4	16.3

Table 4: Predictors of Baseline Sexual Function

Variable	Multivariate Regression Analysis		
	Estimate	SE	p-value
Age (ref = <40)			
40-59	0.73	0.20	**0.0003**
60-69	1.00	0.23	**<.0001**
>70	0.81	0.27	**0.0028**
Gender (ref = Female)			
Male	0.06	0.17	0.7073
BMI (ref = <25)			
25-30	0.30	0.16	0.0629
≥30	0.31	0.18	0.0893
CCI (ref = 0)			
1	0.05	0.17	0.7535
2	0.10	0.19	0.5929
≥3	0.26	0.19	0.1720
Previous Fusion (ref = No)			
Yes	0.22	0.15	0.1497
Baseline Alignment/HRQOL			
Pelvic Tilt	-0.01	0.01	0.2109
Pelvic Incidence	0.00	0.01	0.9580
SVA	0.00	0.00	**0.0214**
Maximum Cobb Angle	-0.01	0.00	0.1431
Back Pain NSR	0.13	0.03	**<.0001**

Table 5: Predictors of 2-Year Change From Baseline Sexual Function

Variable	Multivariate Regression Analysis		
	Estimate	SE	p-value
Age (ref = <40)			
40-59	-0.10	0.30	0.7344
60-69	-0.03	0.33	0.9238
>70	0.40	0.40	0.3100
Gender (ref = Female)			
Male	-0.01	0.24	0.9663
BMI (ref = <25)			
25-30	0.05	0.22	0.8275
≥30	0.22	0.24	0.3613
CCI (ref = 0)			
1	0.17	0.23	0.4645
2	-0.37	0.27	0.1842
≥3	-0.24	0.26	0.3548
Previous Fusion (ref = No)			
Yes	-0.11	0.22	0.6267
ASA (ref = 1/2)			
3/4	0.03	0.20	0.8939
Pelvic Fixation (ref = No)			
Yes	0.03	0.30	0.9103
Postoperative Revision (ref = No)			
Yes	-0.41	0.22	0.0700
Levels Fused (ref = 0-8)			
9-10	-0.25	0.28	0.3627
11-15	-0.01	0.28	0.9689
≥16	-0.23	0.26	0.3823
2-Year Change From Baseline Alignment/HRQOL			
Pelvic Tilt	-0.01	0.01	0.2874
Pelvic Incidence	-0.02	0.03	0.4822
SVA	0.01	0.00	**0.0032**
Maximum Cobb Angle	-0.01	0.01	0.2203
Back Pain NSR	0.17	0.03	**<.0001**

Abbreviations:

ASD: adult spinal deformity

LSDI: lumbar stiffness disability index

HRQOL: health-related quality of life

SD: standard deviation

ODI: Oswestry Disability Index

SVA: sagittal vertical axis

SRS: Scoliosis Research Society

PT: pelvic tilt

TK: thoracic kyphosis

BMI: body mass index

ASA: American Society of Anesthesiologists

NSR: numeric scale rating