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Healthy years of life gained after minimal invasive spine surgery in lumbar degenerative disease. Medial-central approach

Vida saludable ganada por cirugía mínimamente invasiva en patología degenerativa lumbar quirúrgica. Abordaje central-medial

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Palabras clave:
enfermedad degenerativa de la columna, cirugía endoscópica de columna, fijación lumbar, vida saludable, años de vida perdidos.

ABSTRACT

Introduction: the burden of disease in a population is determined by prevalence, premature death, and disability due to either acute or chronic complications. **Objective:** determine the healthy years of life gained after a lumbar percutaneous (medial-central approach) transpedicular-fixation endoscopic minimally invasive spine surgery, in patients with lumbar degenerative disease. **Material and methods:** Oswestry disability index was employed for the estimation of years of life lost per patient. A minimally invasive spine surgery was performed, and Oswestry disability index was evaluated during a month, 3-months, 6-months, and 12-months follow-up. Healthy years of life lost due to disability were calculated prior to surgery, and compared to healthy years of life lost after surgical treatment and during follow-up. The difference of pre-surgical and post-surgical healthy years of life lost due to disability was considered as the total years of life gained due to lumbar percutaneous transpedicular-fixation endoscopic minimally invasive spine surgery. **Results:** healthy years of life lost per patient with lumbar degenerative surgical disease with non treatment was of 9.91 years. Healthy years of life gained after a lumbar percutaneous (medial-central approach) transpedicular-fixation endoscopic minimally invasive spine surgery was 9.83 years. **Conclusion:** healthy years of life lost per patient were almost totally recovered after a lumbar percutaneous (medial-central approach) transpedicular-fixation endoscopic minimally invasive spine surgery.

RESUMEN

Introducción: *la carga de enfermedad en una población está determinada por la prevalencia, la muerte prematura y la discapacidad debida a complicaciones agudas o crónicas.* ***Objetivo:*** *determinar los años de vida saludable ganados después de una cirugía endoscópica de columna lumbar percutánea (abordaje medial-central) de fijación transpedicular mínimamente invasiva, en pacientes con enfermedad degenerativa lumbar.* ***Material y métodos:*** *se utilizó el índice de discapacidad de Oswestry para estimar los años de vida perdidos por paciente. Se realizó una cirugía de*

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columna mínimamente invasiva y se evaluó el índice de discapacidad de Oswestry durante 1, 3, 6 y 12 meses de seguimiento. Los años de vida saludables perdidos debido a una discapacidad se calcularon antes de la cirugía y se compararon con los años de vida saludables perdidos después del tratamiento quirúrgico y durante el seguimiento. La diferencia de años de vida saludables pre-quirúrgicos y postquirúrgicos perdidos debido a discapacidad se consideró como el total de años de vida ganados debido a la cirugía endoscópica de columna mínimamente invasiva con fijación transpedicular percutánea lumbar. ***Resultados:*** *los años de vida saludable perdidos por paciente con enfermedad quirúrgica degenerativa lumbar sin tratamiento fueron de 9.91 años. Los años de vida saludable ganados después de una cirugía endoscópica de columna lumbar percutánea (abordaje medial-central) con fijación transpedicular mínimamente invasiva fueron 9.83 años.* ***Conclusión:*** *los años de vida saludables perdidos por paciente se recuperaron casi por completo después de una cirugía endoscópica de columna mínimamente invasiva con fijación transpedicular percutánea lumbar (abordaje medial-central).*

INTRODUCTION

The burden of disease in a population is determined by prevalence, premature death, and disability due to either acute or chronic complications.[1-4]

These parameters all-together fault a person's life and eventually lead to loss of healthy years-life, which is identified in epidemiology as healthy years of life lost (HYLL).[5]

Besides the utility of HYLL as an overall health-parameter in a population, it has been employed as an indicator to evaluate effectiveness of a different decision-making and actions in a population's health. In many previously reported economical evaluation studies, HYLL have been measured and referred to play an important and determining role in public-healthcare policies.[6,7]

In the estimation of HYLL, there are several objective parameters such as life expectancy and age-specific incidence. Nevertheless, when disability is estimated, we face a subjective scenario dependent on either the patient's or physician's perspective in time and function. Having said that, in the field of spine surgery and for the proper evaluation of lumbar-spine disease disability, it is quite helpful to use the Oswestry disability index (ODI), also known as the Oswestry low back pain disability questionnaire.[8-10]

The demographic transition[11] along with an increase in life expectancy and the epidemiological transition[12] associated to an increased incidence of chronic-degenerative disease, are a sum of epidemiological variables that have influenced for spine degenerative diseases as a current public health challenge that has aimed as a whole to improve and innovate our daily neurosurgical practice in order to address this problem in our patient population.[13-15]

In the last two-decades, the evolution of spine surgery procedures has been impressive. Particularly, endoscopic and minimally invasive techniques are now a reality that has not only modified our clinical practice, but also transformed and improved our patients' neurological outcome.[16-18]

In this context, the purpose is to determine the healthy years of life gained (HYLG) after a minimal invasive spine surgery (medial-central approach), in patients with lumbar degenerative disease.

MATERIAL AND METHODS

Our patient selection for this study consists of a group of patients with lumbar degenerative disease, attended at the neurosurgery ambulatory consultation and follow-up, eligible for surgical treatment according to medical criteria. A medial-central approach minimally invasive spine surgery[18] was performed on each of the patients, with post-surgical follow-up and medical attention, from January 2016 to December 2018.

Patients included to this study were previously evaluated for endoscopic fixation and 4 further evaluations were registered during their first year of post-surgical follow-up (1, 3, 6 and 12 months).

Since the study was performed with the total number of patients surgically treated and followed during the period of this study (three years), neither sample size was estimated nor sample design technique. A total of 79 patients were included in this study.

HYLG was measured according to the following criteria:

1. Healthy life lost due to presurgical disability and during the first post-surgical year follow-up. To determine the healthy life lost due to disability, patients were interviewed and the Oswestry

disability index also known as the Oswestry low back pain disability questionnaire was applied. This validated questionnaire identifies 10 different aspects of basic daily life activities (pain, personal care, weight lifting, deambulation, sitting, standing, sleeping, sexual activity, social life, traveling). In every basic daily activity aspect (BDAA), the minimum score is 0 and maximum score is 5 (0 refers to best possible performance, 5 refers to worst possible performance or inability). Total maximum score is 50 and minimum is 0.

   a. Healthy life lost due to disability was evaluated prior to surgery. For statistical purposes, we assumed the obtained estimation represented the disability of a year of life, and this obtained result was the same for the total of years-lived applying 3% discount per year in patients with a lumbar degenerative disease.
   b. Post-surgery healthy life lost due to disability was obtained in 4 different periods of time: 1 month (31 days), 3 months (59 days), 6 months (91 days), and 12 months (184) post-surgical follow-up.

2. Percentage of healthy life lost.
   a. The obtained Oswestry Disability Index score in each BDAA was divided by 50 (maximum score) and was expressed as a percentage. The result meant the healthy life lost per BDAA, per total, and per period prior to surgery, assuming the amount of possible days for a month (31 days), between two-to-three months (59 days), fourth-to-sixth months (91 days), and seventh-to-twelfth months (184 days), respectively.
3. Healthy life lost due to disability during the first post-surgical year.
   a. The percentage of healthy life lost was multiplied by the total of days that address each of the time-periods stipulated for the post-surgical follow-up of one year: 31 days for the first month, 59 days between the second to third month, 91 days between the fourth to sixth month, 184 days between the seventh to twelfth month follow-up. The result of the multiplication determined the total days of healthy life lost per period of time, due to disability.
4. Healthy life gained during the first post-surgical year.
   a. The total days lost prior to surgery was subtracted to the total post-surgical lost days. The difference determined the total number of days gained during the first post-surgical year.
5. Healthy days of life lost (HDLL) due to disability a year prior to surgery.
   a. The HDLL due to disability a year prior to surgery were divided for the total of days per year (365). The result was multiplied by the total of days of each period (31 days for the first month, 59 days between the second to third month, 91 days between the fourth to sixth month, 184 days between the seventh to twelfth month, respectively).
6. Healthy days of life gained (HDLG) during the first post-surgical year.
   a. A subtraction was calculated among the healthy life days lost due to disability per period of time prior to surgery and the healthy days of life lost (HDLL) per period during the first post-surgical year.
   b. The subtraction result determined the HDLG during the first post-surgical year of life.
7. Healthy years of life lost (HYLL) due to disability in life, without surgery.
   a. Mean age of lumbar degenerative disease (with surgical eligibility) incidence was calculated (50.02 years-old).
   b. Life expectancy of the studied population was considered according to national epidemiological and statistical census (75.20 years).[19]
   c. The difference between mean age of incidence and life expectancy was considered as the period of time lived with lumbar degenerative disease with surgical eligibility (25.18 years).
   d. The subtraction result was then multiplied per the HDLL due to disability, a year prior to surgery.
   e. The previous multiplication result determines the total of HDLL due to disability in life. The discount rate of 3% per year was applied.
8. Healthy days of life gained (HDLG) during the first year and in life post-surgically.
   a. HDLG during first post-surgical year:
      a.1. The difference among HYLL due to disability prior to surgery and HYLL during the first post-surgical year was considered.
   b. HDLG per year after the first post-surgical year:
      b.1. We considered the healthy life gained during the period between the seventh-to-twelfth month.
      b.2. This previous obtained result was considered as the annual healthy life gained from second year applying the 3% discount.
      b.3. Same previous result was multiplied by the total time-lived (difference among life expectancy and mean-age of lumbar

degenerative disease with surgical eligibility diagnosis).

c. HDLG during the rest of post-surgical life:
   c.1. For statistical purposes, HDLG during the rest of post-surgical life included the first year's result plus the HDLG per year after the first post-surgical year.

9. Healthy years of life lost (HYLL) due to disability in life prior to surgery.
   a. The total of HDLL due to disability prior to surgery was divided per the total days of a year (365 days). The obtained result determined the total HYLL due to lumbar degenerative disease with no surgery performed.
10. Healthy years of life gained (HYLG) in life post-surgically.
   a. The total of HDLG in life post-surgically was divided per the total days of a year (364 days). The obtained result determined the total HYLG post-surgically in lumbar degenerative disease eligible for surgery (and performed).
   The total estimation of HDLL, HDLG and HYLG was calculated for each patient.

Other variables considered

Age, sex and pre-surgical diagnosis were obtained.

The application and evaluation with the Oswestry disability index[8,9] was performed by the same investigator.

Statistical analysis included mean (age, disability, healthy life, healthy life days and healthy life years), confidence interval for mean (age), percentage (sex, diagnosis and healthy life) and confidence interval for percentage (sex and diagnosis).

The manuscript is a product of medical practice; therefore, all patients were informed of the procedure and provided informed consent.

RESULTS

Mean age of the studied population was 50.02 years-old (CI 95%; 48.59-55.45), with a male predominance 51.9% (CI 95%; 40.6-63.1). Up to 79.7% (CI 95%; 70.8-88.6) of studied patients were diagnosed with lumbar spinal stenosis and 20.3% (CI 95%; 11.7-29.5) with spondylolisthesis.

'Pain' and 'sitting position' were the most affected BDAA in patients with lumbar degenerative disease eligible for surgery. Average scores for 'pain' and 'sitting position' BDAA were 3.41 and 3.20, respectively. A month after surgery, 'sexual activity' obtained the lower average score (0.37). At the end of the first year after surgery, all BDAA evaluated reported an average score of 0.04 or less. BDAA evaluated per time period are described in *Table 1*.

Healthy life lost prior to surgery is 55.50%, where 6.82% corresponds to 'pain' BDAA and 5.56% to 'sitting position'. A month after surgery, total healthy life lost percentage was 21.58% and by the end of the first post-surgical year it decreased to 0.36%. Healthy life lost percentages for each BDAA per time period evaluated is described in *Table 2*.

Table 1: Disability prior to surgery and a year after surgery in patients with lumbar degenerative disease with surgical treatment eligibility.

Basic daily activities aspects	Disability prior to surgery	Disability after surgery			
		1st month (31 days)	2nd-to-3rd month (59 days)	4th-to-6th month (91 days)	7th-to-12th month (184 days)
Pain	3.41	1.04	1.00	0.03	0.03
Personal care	2.48	1.08	1.01	0.03	0.03
Weight lifting	3.15	1.43	1.01	0.01	0.01
Deambulate	2.78	1.16	1.15	0.01	0.01
Sitting	3.20	1.18	1.06	0.04	0.04
Standing	3.03	1.22	1.01	0.01	0.01
Sleeping	2.62	1.15	1.00	0.03	0.03
Sexual activity	1.01	0.37	0.34	0.00	0.00
Social life	3.08	1.05	1.01	0.01	0.01
Traveling	2.99	1.11	0.99	0.01	0.01

In each aspect, minimum score is 0 and maximum score is 5 (0 stands for best, 5 stands for worst scenario). Disability evaluation was performed with the Oswestry disability index (ODI).

Table 2: Healthy life lost per period of time percentage, healthy life lost (days) and healthy life gained (days) in the first year after surgery in patients with lumbar degenerative disease and surgical treatment eligibility.

	Healthy life lost due to disability percentage					Healthy life lost due to disability measured in days						Healthy days gained on 1st year after surgery
		After surgery					After surgery					
Basic daily activities aspects	Prior to surgery (365 days)	1st month (31 days)	2nd-3rd month (59 days)	4th-6th month (91 days)	7th-12th month (184 days)	Prior to surgery (365 days)	1st month (31 days)	2nd-3rd month (59 days)	4th-6th month (91 days)	7th-12th month (184 days)	Healthy days lost on 1st year	
Pain	6.82	2.08	2.00	0.06	0.06	24.89	0.64	1.18	0.05	0.11	1.99	22.90
Personal care	4.96	2.16	2.02	0.06	0.06	18.10	0.67	1.19	0.05	0.11	2.03	16.08
Weight lifting	6.30	2.86	2.02	0.02	0.02	23.00	0.89	1.19	0.02	0.04	2.13	20.86
Deambulate	5.56	2.32	2.30	0.02	0.02	20.29	0.72	1.36	0.02	0.04	2.13	18.16
Sitting	6.40	2.36	2.12	0.08	0.08	23.36	0.73	1.25	0.07	0.15	2.20	21.16
Standing	6.06	2.44	2.02	0.02	0.02	22.12	0.76	1.19	0.02	0.04	2.00	20.12
Sleeping	5.24	2.30	2.00	0.06	0.06	19.13	0.71	1.18	0.05	0.11	2.06	17.07
Sexual ctivity	2.02	0.74	0.68	0.00	0.00	7.37	0.23	0.40	0.00	0.00	0.63	6.74
Social life	6.16	2.10	2.02	0.02	0.02	22.48	0.65	1.19	0.02	0.04	1.90	20.59
Travelling	5.98	2.22	1.98	0.02	0.02	21.83	0.69	1.17	0.02	0.04	1.91	19.92
	Percentage					Days						
Total	55.50	21.58	19.16	0.36	0.36	202.58	6.69	11.30	0.33	0.66	18.98	183.59

The total HDLL due to disability a year prior to surgery was 202.58 days. A year after surgery the total HDLL was estimated at 18.98 days, meanwhile the total HDLG was 183.59 days. Detailed description per BDAA per time period in *Table 2*.

Lumbar degenerative disease with surgical eligibility with no surgery performed, 17.21 HDLL due to disability on Likewise, a total of 32.75 HDLL were calculated between the second-to-third months after diagnosis, with no surgery performed, in contrast to 21.44 HDLG if surgery was performed. Among the fourth-to-sixth month, a total of 50.51 HDLL with no surgery, whilst 50.18 HDLG with surgery. The trend results were similar during the seventh-to-twelfth months: HDLL 102.12 and HDLG 101.46. Total HDLL in a year with no surgery is 202.58, meanwhile with surgery a total of 183.59 days were gained. Detailed description per BDAA per time period in *Table 3*.

Patients eligible for surgery treatment to whom no surgery was performed were estimated with a total of 3,297.54 HDLL due to disability. Patients treated with surgery were estimated with a total of 183.59 HDLG during their first year post-surgery and a total estimation of 2,988.51 HDLG overall. Detailed description per BDAA per time period in *Table 4*.

Patients with lumbar degenerative disease eligible for surgery were estimated with a total of 9.03 HYLL, compared to 8.19 HYLG in patients to whom surgery was performed. *Table 5* provides the BDAA per time described.

DISCUSSION

The burden of the disease in a population is a term previously reported in the literature. There are several empirical and hypothetical health-interventions estimated in order to evaluate HYLG.[20,21] In this preamble is the purpose of our manuscript, where we estimate the weight of lumbar degenerative surgical disease as well as the resulting HYLG after surgical treatment.

Some of the methodological strengths of this manuscript are the follow-up of patients up to 12 months; a follow-up that was evaluated periodically by the same Investigator and treating physician. This may assure the same clinical and surgical criteria on the expertise of the same medical specialist, maintaining an objective and consistent criteria application and data obtention. However, we must recognize that a 12-month follow-up clinical evaluation to conclude the HYLG overall may be still not enough follow-up to draw recovery conclusions in terms of HYLG. If this is the case, this may be a limitation of follow-up, since a 12-month post-surgical follow-up does not

necessarily represent the ongoing recovery of the patient, perhaps the expected.

There is no doubt that the BDAA with a higher HYLG are the ones that prior to surgical treatment were described with the most HYLL. This has a logical order in functionality recovery and may be interpreted as a high efficacy of the surgical procedure as a plausible and recommended option of treatment.

When comparing HYLL due to lumbar degenerative surgical disease with other chronic diseases such as diabetes or hypertension,[22] values are not only similar but slightly higher, respectively. Nevertheless, during HYLL analysis the primary cause of HYLL in lumbar disease is disability itself, meanwhile in diabetes of hypertension the primary cause of HYLL is premature death. This difference of primary cause in HYLL

Table 3: Healthy life days lost and healthy life days gained during the first year, per period of time (prior and after surgery) in patients with lumbar degenerative disease and surgical treatment eligibility.

	Healthy days of life									
	1st month (31 days)		2nd-3rd month (59 days)		4th-6th month (91 days)		7th-12th month (184 days)		1 year (365 days)	
Basic daily activities aspects	Lost before	Gained after	Lost before	Gained after	Lost before	Gained after	Lost before	Gained after	Lost before	Gained after
Pain	2.11	1.47	4.02	2.84	6.21	6.15	12.55	12.44	24.89	22.90
Personal care	1.54	0.87	2.93	1.73	4.51	4.46	9.13	9.02	18.10	16.08
Weight lifting	1.95	1.07	3.72	2.53	5.73	5.71	11.59	11.56	23.00	20.86
Deambulate	1.72	1.00	3.28	1.92	5.06	5.04	10.23	10.19	20.29	18.16
Sitting	1.98	1.25	3.78	2.53	5.82	5.75	11.78	11.63	23.36	21.16
Standing	1.88	1.12	3.58	2.38	5.51	5.50	11.15	11.11	22.12	20.12
Sleeping	1.62	0.91	3.09	1.91	4.77	4.71	9.64	9.53	19.13	17.07
Sexual activity	0.63	0.40	1.19	0.79	1.84	1.84	3.72	3.72	7.37	6.74
Social life	1.91	1.26	3.63	2.44	5.61	5.59	11.33	11.30	22.48	20.59
Traveling	1.85	1.17	3.53	2.36	5.44	5.42	11.00	10.97	21.83	19.92
Total	17.21	10.52	32.75	21.44	50.51	50.18	102.12	101.46	202.58	183.59

Table 4: Healthy life days lost and gained due to disability prior and after surgery, after a year and in life overall, in patients with lumbar degenerative disease and surgical treatment eligibility.

	Healthy life days lost		Healthy life years gained		
	Prior to surgery		After surgery		
Basic daily activities aspects	Per year	In life overall	1st year	Per year after the 1st year	In life overall
Pain	17.09	444.38	22.90	16.94	440.53
Personal care	12.43	323.18	16.08	12.28	319.30
Weight lifting	15.79	410.50	20.86	15.68	407.74
Deambulate	13.93	362.28	18.16	13.83	359.53
Sitting	16.04	417.01	21.16	15.86	412.33
Standing	15.19	394.86	20.12	15.09	392.24
Sleeping	13.13	341.43	17.07	12.98	337.51
Sexual activity	5.06	131.62	6.74	5.04	130.99
Social life	15.44	401.37	20.59	15.34	398.86
Traveling	14.99	389.65	19.92	14.89	387.11
Total	139.09	3,616.28	183.59	137.93	3,586.13

Table 5: Healthy life years lost and healthy life years gained per patient, prior and after surgery in patients with lumbar degenerative disease and surgical treatment eligibility.

Basic daily activities aspects	Healthy life years	
	Lost in life	Gained in life
	Prior to surgery	After surgery
Pain	1.22	1.21
Personal care	0.89	0.87
Weight lifting	1.12	1.12
Deambulate	0.99	0.99
Sitting	1.14	1.13
Standing	1.08	1.07
Sleeping	0.94	0.92
Sexual activity	0.36	0.36
Social life	1.10	1.09
Traveling	1.07	1.06
Total	9.91	9.83

among degenerative disease not only remarks the area of opportunity in each public health issue, but enhances the importance of a surgical intervention as an alternative that may recover HYLL in a clinically eligible population.

A total of 9.03 HYLL due to a lumbar-spine degenerative disease represents a vast negative impact in a patient's life that, according to our mean of age (50.02 years-old) of disease incidence, it may be an overwhelming limitation in productivity, social, and personal wealth matters. Nevertheless, a total of 8.19 HYLG after surgical treatment, not only reflects the progress in medical and surgical techniques to treat patients, but also demonstrates that in surgical-eligible patients this results may not be transpolated or replicated with exclusive physical therapy and rehabilitation, since this conservative treatment option not only requires a higher amount of time-invested, but a possibility of increasing HYLL consequently, if not being successful due to the advanced degenerative disease.

From an economic perspective, a cost-effectiveness analysis should be necessary in order to identify the cost of every HYLG as well as the total productivity cost of each HYLL. From the patients' social and personal perspective, the wealth-gained in interpersonal relationships and quality of life should be analyzed, yet with our obtained data this analysis is not possible to be estimated. We consider these results need further analysis with several other variables to consider, as well as this presented results should be replicated and compared to other distinct surgical techniques that are also suitable to be performed in lumbar degenerative disease with surgical eligibility.

CONCLUSIONS

Our conclusion is that lumbar-spine degenerative disease has a high HYLL per patient. In carefully selected cases for surgical treatment, minimally invasive spine surgery (medial-central approach) may offer a high expectation of recovery measured by HYLG to the patient, a result that not only denotes an improvement in quality of care, but reflects medical progress in the spine surgery field that improves patient's health and BDAA as a whole.

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