Acta Ortopédica Mexicana 2018; 32(2): Mar.-Abr: 60-64

Original article

Epidemiological and radiological profile of patients with degenerative scoliosis: 20 year experience at a referral institute

García-Ramos CL,* Obil-Chavarría CA,* Molina-Choez DD,* Reyes-Sánchez A*

National Institute of Rehabilitation.

ABSTRACT. ***Background:*** **Adult degenerative scoliosis is a complex three-dimensional rotational deformity, in a previously straight spine, resulting in sagittal and axial disbalance.** ***Material and methods:*** **This retrospective study presents the casuistry of patients 40 to 80 years old with adult degenerative scoliosis who underwent surgery in a referral institute from January 1994 to December 2013.** ***Results:*** **The prevalence was 0.087% (CI 95% 67.8-111), with a median age of 64.9 ± 9.4 years old, increased frequency in women and older adults. The prevalence of spondylolisthesis associated with degenerative scoliosis was 21%. The estimated risk for scoliosis in women was OR = 2.37 (CI 95% 1.35-4.15), while men showed OR = 0.4 (CI95% 0.24-0.73). The risk for spondylolisthesis associated to degenerative scoliosis was in men OR = 1.87.** ***Conclusions:*** **The prevalence in our experience is low and the sample age was higher; while gender, severity of the curve and presence of spondylolisthesis and olistesis were similar to the reviewed literature.**

Key words: Adult scoliosis, degenerative scoliosis, scoliosis de novo, spine deformity, prevalence, epidemiology.

RESUMEN. ***Antecedentes:*** **La escoliosis degenerativa del adulto es una deformidad rotacional tridimensional compleja, en una columna recta previamente, dando por resultado desequilibrio sagital y axial.** ***Material y métodos:*** **Este estudio retrospectivo presenta la casuística de los pacientes de 40 a 80 años de edad con escoliosis degenerativa del adulto que experimentaron la cirugía en un instituto de referencia desde enero de 1994 a diciembre de 2013.** ***Resultados:*** **La prevalencia fue de 0.087% (IC 95% 67.8-111), con una edad media de 64.9 ± 9.4 años, mayor frecuencia en mujeres y adultos mayores. La prevalencia de la espondilolistesis asociada a escoliosis degenerativa fue de 21%. El riesgo estimado para la escoliosis en las mujeres fue = 2.37 (IC 95% 1.35-4.15), mientras que los hombres mostraron OR = 0.4 (IC95% 0.24-0.73). El riesgo de espondilolistesis asociada a escoliosis degenerativa fue en hombres OR = 1.87.** ***Conclusiones:*** **La prevalencia en nuestra experiencia es baja y la edad de la muestra fue mayor; mientras que el género, la gravedad de la curva y la presencia de espondilolistesis y olistesis eran similares a la literatura consultada.**

Palabras clave: Escoliosis del adulto, escoliosis degenerativa, escoliosis *de novo*, deformidad de la columna vertebral, prevalencia, epidemiología.

Level of evidence: III

* Spine Surgeon. National Institute of Rehabilitation.

Corresponding autor:
Dr. Alejandro Reyes-Sánchez
Chief of Spine Surgery Division. National Institute of Rehabilitation.
289 avenue México-Xochimilco,
Arenal de Guadalupe, Tlalpan, Z.P. 14389, Ciudad de México, México.
Phone: (+52) (55) 5999 1000, exts. 12206 y 12209
Celphone: 044 55 5413 8587
E-mail: alereyes@inr.gob.mx, areyes@vertebrae.com.mx

Introduction

Adult scoliosis is a three-dimensional complex rotational deformity caused by an ongoing degeneration of the spine elements at maturity, on a former straight spine; with a Cobb angle > 10° on a coronal level, which furthermore alters the sagital and axial levels.[1,2,3]

Aebi classifies it into three groups:

Type I: degenerative, primary or *de novo*. It shows after skeletal maturity. It is secondary to degenerative changes on the discs and articular sides. It mostly appears on the lumbar spine.

Type II: idiopathic, progressive. It shows before skeletal maturity and becomes symptomatic at an adult age.

Type II: adult secondary scoliosis. It is secondary to structural deformities or metabolic disease.[3]

The prevalence for degenerative scoliosis varies from 2.5% to 15% in controlled populations versus 7.5% to 9.1% in individuals with associated lumbar pain.[4,5]

While deformity is the main symptom of idiopathic scoliosis in adolescents, there are several symptoms for the degenerative kind.[3,6,7,8,9] However, the axial pain is the most frequent claim, reported in 40 to 90% of the cases, mainly when standing or sitting; and it diminishes when the patient releases the weight off the spine by taking a supine or side position. The pain shows on the convexity (75% of all cases) on the curve, on trigger points on muscle insertions around the iliac crest bone and sacrum. It may also be difuse on the affected spinal area.[3,6]

Conservative treatment includes both drugs and physical therapy.[1,9,10,11] The epidural and facet injections for selective blocking of nerve roots act as short term pain relievers.[3] Patients with non-treatable pain, radiculopathy and/or neurological impairment would undergo surgery.[1,11,12]

There is not a consensus for surgical indications; however, symptoms and clinical signs must be clearly understood.[1,13] Surgery aims at the pressure relief of neural components through restoring and stabilizing the coronal and sagital balance.[10] Surgical options include decompression, *in situ* decompression and decompression with fusion (anterior and/or posterior).[1,13,14] Nowadays, it is known that coronal and sagital balance must be re-established in order for the deformity to be modified in a three-dimensional fashion and not only try to re-establish the sagital or coronal deformity.[15]

In the United States, the reported prevalence of adult degenerative scoliosis is estimated between 60 to 68%.[1] Life expectancy in our population has increased together with advances in medical technology, resulting in changes in the population pyramid. The latter, together with the quest to improve quality of life within this group, makes adult degenerative scoliosis a more common problem for clinicians.[5,16,17]

The main goal of this study is to analyze the epidemiological, clinical and radiographic aspects in patients with the pathology, who have been diagnosed and taken care of in a referral institution in the last 20 years. The secondary purpose is to determine prevalence and spondylolisthesis level concomitant to adult scoliosis.

Material and methods

It is an analytic, observational, retrospective study. Information was gathered from the data base of admisssion to the Institute. The diagnosis from the data base was double checked by a spine surgeon and a neurosurgeon from the Institute yet, external to this study. The patient's electronic and radiographic records were depicted. The inclusion criteria was: 40 to 80 year-old men and women, diagnosed with adult degenerative scoliosis who had surgical treatment in the spine surgery division of our institute due to lumbar, radicular pain and/or neurological impairment, from January 1994 to December 2013, whose electronic and radiographic records were complete.

The analyzed variables were: age, gender, spondylolisthesis presence, olisthesis presence, Cobb angle in the deformity (measured in degrees in the anteroposterior (AP) and lateral panoramic spine X-rays), curve levels and severity, type of treatment, hospitalization time and complications.

Proposed statistical analysis: The sample was grouped based on gender, age ranges (young adult = 18 to 45; middle adult = 46 to 60 and elderly ≥ 61), curve magnitude (slight: from 11° to 22°, moderate: 21° to 40° and severe: > 41°). Descriptive statistics was used for quantitative variables through measures of central tendency and dispersion. Qualitative variables were measured through percentages. To contrast the differences between groups, through nominal variables, the χ^2 or Fisher's Exact Test was used. For data with normal distribution, the comparison between medias for related data, with the Paired T-Test for the Cobb angle pre and post surgery values. If the normality requirement was not accomplished, the non parametric Wilcoxon signed-Rank Test was used A $p < 0.05$ was established as a significant difference. Data were analyzed with The SPSS v.21.0 (SPSS, Chicago, Illinois) statistical package.

Results

Prevalence of lumbar scoliosis in adults according to demographic variables.

Within the period from 1994 to 2013, it was estimated a prevalence of 87/100,000 (CI 95% 67.8-111) patients with adult degenerative scoliosis.

Degenerative lumbar scoliosis was more often found among women from that group 72.1% (44/61) and 27.9% (17/61) among men, at a ratio of 2.6:1. An increase in frequency by age group was observed: young adults: 3.3% (2/61), 26.2% (16/61) in middle adults and 70.5% (43/61) in the elderly *(Table 1)*.

In the general population, the lowest and highest ages were 41 and 79 with a median of 64.9 ± 9.4 years old (CI

95% 62.2-66.8). In the gender based analysis, the lowest and highest ages in men were 46 and 79, with an average of 64.9 years (± 9.5 CI 95% 62.1-67.5); whereas in women the lowest and highest ages were 41 and 78, with a 64.9 year old average (± 9.4 CI 95% 62.2-66-8), (p = 0.953).

Prevalence of spondylolisthesis associated to degenerative lumbar scoliosis according to demographic variables

The prevalence of spondylolisthesis associated to degenerative lumbar scoliosis was 21% (13/61 patients). In the analysis by gender an increased prevalence among women was found to be 3.52% (8/44) compared to men with 0.8% (5/17).

The most affected level was that of L4-L5 with 61.5% (8/13 patients), one patient with listhesis L3-L4 and one with listhesis L5-S1, which represent 7.7% in each case. Listhesis in more than one segment was reported in 23.1% (3/13 patients). By age groups, there was an increase in the > 61 (61.5%) compared to a < 61 (38.5%). Listhesis was present in 7.7% (1/13) of the slight curves and in 92.3% (12/13) of the moderate ones.

Estimated risk based on demographic variables

Women showed 2.4 times the risk of suffering from degenerative lumbar scoliosis. (OR = 2.37, CI95% 1.35-4.15, p = 0.005), while men showed OR = 0.4, IC95% 0.24-0.73, p = 0.005).

Men showed 1.9 times the risk of suffering from spondylolisthesis associated to degenerative lumbar scoliosis (OR = 1.87, CI 95% 0.51-4.25, p = 0.005).

Radiologic variables

Olisthesis

The level with the highest presence of olisthesis was L-5-S1, with 62.3 % (38/61 patients). The second highest was L4-L5 with 29.5% corresponding to 18/61 patients. The L3-L4 level represented 8.2% with 5/61 patients. A 1.33 mm minimum and 8 mm maximum displacement and 4.5 ± 1.73 mm as the mean was reported.

Severity of scoliosis

The highest vertebral levels involved in the lumbar curves were 2 and 5. With an agulation measured with the Cobb technique, a curve from 16º to 40º with a 30.95º ± 4.9 mean (CI 95% 29.69-32.13) was documented. Men showed an average angulation of 31.23º ± 4.1 (CI 95% 29.31-33.21); women had an average angulation of 30.84º ± 5.8 (CI 95% 29.28-32.41), representing a non significant difference between genders *(Table 2)*.

Surgical variables

To compare the correction obtained in the post surgical lumbar scoliosis deformity with two different techniques (only posterior approach or double approach), the pre surgery Cobb angle was measured. The latter showed values from 16º to 40º (mean = 30.95º ± 4.9). While, the post surgery Cobb angle went from 18º to 40º (mean = 31.13º ± 4.3). Student's t Test for related samples was done for the Cobb angle analysis both pre and post surgery (p = 0.797), therefore, there was a significant change after surgery.

The type of approach used was posterior (82%) son 50 ocassions and 11 patients (18%) through a double approach (anterolateral transpsoas approach-ALPA and posterior). The number of in-hospital days go from 1 to 28 (mean = 3.30 days). 86.9% of the patients (53/61) did not have immediate or mediate post surgical complications; 7 patients (11.5%) had incidental durotomies at the moment of surgery and one patient (1.6%) developed a superficial infection of the surgical wound.

Discussion

This study presents the casuistry of those patients who were handled surgically in a referral and specialized Institute over a 20 year period and who were disgnosed with adult degenerative scoliosis.

Table 1: Pre-operative radiologic parameters for operatively treated adults with scoliosis stratified based on age group.

Severity of the curve	Slight (11-20º) n = 2	Moderate (21-40º) n = 59	Total (%)	p
Age group (years)				
Young adults (up to 45)	0	2 (100%)	2 (100)	0.000
Middle adults (46-60)	0	16 (100%)	16 (100)	0.000
Older age group (>60)	2 (4.7%)	41 (95.3%)	43 (100)	0.000
Total	2 (3.3%)	59 (96.7%)	61 (100)	

Table 2: Pre-operative radiologic parameters for operatively treated adults with scoliosis stratified based on patient gender group.

Severity of the curve	Slight (11-20º) n = 2	Moderate (21-40º) n = 59	Total (%)	p
Gender				
Female	2 (4.5%)	42 (95.5%)	44 (100)	0.001
Male	0	17 (100%)	17 (100)	0.001

The middle age of presentation in our populationn was 64.6 years old ± 9.4; which differs from what was reported by Tsutsui with a mean = 53.1 ± 15.4 years old and from that reported by Perennou with a mean = 53.1 ± 15.4 and Anwar 53.1 ± 15.4 years old.[5,18,19] This could be explained due to the fact that our institute treats people who do not have social security and search for medical attention; though they are referred to a specialized institute at a late stage in the natural history of the disease.[20]

Depending on the age, the slight curve (11-20°) was present in two patients, with a minimum presentation age of 61 and a maximum of 78, with a mean = 69.50 years old. The severe curve (21-40°) in 59 patients had a minimum age of presentation of 41 and a maximum of 79, with a mean = 64.52, with p = 0.469.

The gender distribution in our study was 72.1% in women and 27.9% in men, similar to what was observed by Anwar, Perennou and Robin with reports of 70.3%, 72% and 63% of women in their respective studies.[5,19,21]

As in our population Li G. and Tsutsui did not find a statistical significant difference in terms of gender, nor age, for the level of severity of the curve.[12,18]

Scoliosis prevalence

The prevalence of scoliosis in our study was 0.087%, Perennou shows a 7.5% rate of scoliosis in the adult in patients with lower back pain and Kostuik reported a prevalence of 2.5% for lumbar scoliosis.[4,19] Being a specialized Institute, selection criteria and late referral of patients with could explain the low prevalence of our population.

In our sample, the frequency of scoliosis for young adults was 3.3%, 26.2% for middle adults and 70.5% for the elderly. Anwar reported a scoliosis prevalence in the adult of 9.1%, 13.3% and 38.9% in young, middle and elderly adults respectively.[5]

Olisthesis

A higher presence of olisthesis in L5-S1 with 62.3% was observed in our study group, followed by L4-L5 with 29.5%. A 1 mm minimum and 8 mm maximum displacement was reported, with a mean = 4.5 mm. Pritchett reported a 39% of olistheis, mostly in L3-4 and L4-5. Whereas Grubb reported olisthesis mainly in L3 and L4 in 80% with a mean ≥ 5 mm.[22,23]

In our population, there was spondilolisthesis in 21.3%, being L4-L5 the most affected level with 13.1%. Pritchett reported listhesis in 55.5% of his sample, out of which, 28.5% in L4-L5 and multi level listhesis in 5%.[22] Tsutsui reported more listhesis at L3-L4.[18]

Scoliosis severity

96.7% of the patients were classified with moderate scoliosis and 3.3% with light scoliosis. In contrast with what reported by Perennou where 56% suffered from light scoliosis and 44% the moderate and severe ones.[19]

In our population, the mean the Cobb angle was 30.93° ± 4.9°, compared to what was reported by Perennou: 21.2° ± 11.4°.[19] Pritchett reported a mean in the curves of 24° in a study with 200 patients.[22] On the other hand, Tsutsui reported an angle of 13.5°, in a detection study on healthy patients.[18]

Although there is no consensus on surgical indications, surgery is considered as possibly helpful for these patients. Li G reported on 34 patients who underwent surgery and found a statistical significant difference in the pre and post surgery Cobb angle of the high curvature in those patients who were treated with fusion of 6 and 7 levels, as well as improvement on the sagital balance, lead line and apical vertebra translation.[12] The average fusion levels in our patient cohort are lower, being the mean = 3.36 levels, with this possibly being the reason for not finding improvement on the Cobb angle.

Li G reports complications of 17% being radiculopathy the main one with 12%, in our group, we found complication ratios of 13.1% with incidental durotomy at the top (11.5%).[12]

This study is limited because it is retrospective, without controls. A longitudinal, prospective study would provide more information on the patient's profile and a comparative study could help determine different treatment effects.

The changes being held in the demographic characteristics of our population in terms of life expectandy, together with the quest to improve quality of life within the adult group of patients, makes adult degenerative scoliosis a more common problem for clinicians. Understanding the presentation of the disease and its epidemiologic behavior may help improve on time diagnosis and treatment, resulting in higher quality of life levels.

References

1. Kotwal S, Pumberger M, Hughes A, Girardi F. Degenerative scoliosis: a review. *HSS J*. 2011; 7(3): 257-64.
2. Birknes JK, White AP, Albert TJ, Shaffrey CI, Harrop JS. Adult degenerative scoliosis: a review. *Neurosurgery*. 2008; 63(3 Suppl): 94-103.
3. Aebi M. The adult scoliosis. *Eur Spine J*. 2005; 14(10): 925-48.
4. Kostuik JP, Bentivoglio J. The incidence of low-back pain in adult scoliosis. *Spine (Phila Pa 1976)*. 1981; 6(3): 268-73.
5. Anwar Z, Zan E, Gujar SK, Sciubba DM, Riley LH 3rd, Gokaslan ZL, et al. Adult lumbar scoliosis: underreported on lumbar MR scans. *AJNR Am J Neuroradiol*. 2010; 31(5): 832-37.
6. Tribus CB. Degenerative lumbar scoliosis: evaluation and management. *J Am Acad Orthop Surg*. 2003; 11(3): 174-83.
7. Schwab F, Ungar B, Blondel B, Buchowski J, Coe J, Deinlein D, et al. Scoliosis research society-Schwab adult spinal deformity classification: a validation study. *Spine (Phila Pa 1976)*. 2012; 37(12): 1077-82.
8. Smith JS, Shaffrey CI, Glassman SD, Carreon LY, Schwab FJ, Lafage V, et al. Clinical and radiographic parameters that distinguish between the best and worst outcomes of scoliosis surgery for adults. *Eur Spine J*. 2013; 22(2): 402-10.

9. Youssef JA, Orndorff DO, Patty CA, Scott MA, Price HL, Hamlin LF, et al. Current status of adult spinal deformity. *Global Spine J*. 2013; 3(1): 51-62.
10. Smith JS, Shaffrey CI, Berven S, Glassman S, Hamill C, Horton W, et al. Improvement of back pain with operative and nonoperative treatment in adults with scoliosis. *Neurosurgery*. 2009; 65(1): 86-94.
11. Smith JS, Shaffrey CI, Berven S, Glassman S, Hamill C, Horton W, et al. Operative versus nonoperative treatment of leg pain in adults with scoliosis: a retrospective review of a prospective multicenter database with two-year follow-up. *Spine (Phila Pa 1976)*. 2009; 34(16): 1693-98.
12. Li G, Passias P, Kozanek M, Fu E, Wang S, Xia Q, et al. Adult scoliosis in patients over 65 years of age: outcomes of operative versus nonoperative treatment at a minimum 2-year follow-up. *Spine (Phila Pa 1976)*. 2009; 34(20): 2165-70.
13. Crandall DG, Revella J. Transforaminal lumbar interbody fusion versus anterior lumbar interbody fusion as an adjunct to posterior instrumented correction of degenerative lumbar scoliosis: three year clinical y radiographic outcomes. *Spine (Phila Pa 1976)*. 2009; 34(20): 2126-33.
14. Cho KJ, Kim YT, Shin SH, Suk SI. Surgical treatment of adult degenerative scoliosis. *Asian Spine J*. 2014; 8(3): 371-81.
15. Cho KJ, Suk SI, Park SR, Kim JH, et al. Short fusion versus long fusion for degenerative lumbar scoliosis. *Eur Spine J*. 2008; 17(5): 650-6.
16. Kuklo TR. Principles for selecting fusion levels in adult spinal deformity with particular attention to lumbar curves and double major curves. *Spine (Phila Pa 1976)*. 2006; 31(19 Suppl): S132-8.
17. Rhee JM, Boden SD, Flynn JM. *Operative techniques in spine surgery*. EUA: Lippincott Williams & Wilkins, 2013.
18. Tsutsui S, Yoshimura N, Watanuki A, Yamada H, Nagata K, Ishimoto Y, et al. Risk factors and natural history of de novo degenerative lumbar scoliosis in a community-based cohort: the Miyama study. *Spine Deform*. 2013; 1(4): 287-92.
19. Pérennou D, Marcelli C, Hérisson C, Simon L. Epidemiologic aspects in a low-back pain population. *Spine (Phila Pa 1976)*. 1994; 19(2): 123-28.
20. Noriega EM, Franco EJ, Montoya RA, Garduño AM, León CL, Martínez AS y cols. Deterioro de las condiciones de trabajo y de salud en México. *Salud Trab (Maracay)*. 2009; 17(1): 61-7.
21. Robin GC, Span Y, Steinberg R, Makin M, Menczel J. Scoliosis in the elderly: a follow-up study. *Spine (Phila Pa 1976)*. 1982; 7(4): 355-59.
22. Pritchett JW, Bortel DT. Degenerative symptomatic lumbar scoliosis. *Spine (Phila Pa 1976)*. 1993; 18(6): 700-3.
23. Grubb SA, Lipscomb HJ. Diagnostic findings in painful adult scoliosis. *Spine (Phila Pa 1976)*. 1992; 17(5): 518-27.