

# STUDY OF FUNCTIONAL DEPENDENCE BETWEEN CASES OF CERVICAL ARTHRODESIS AND ARTHROPLASTY

*ESTUDO DE CAPACIDADE FUNCIONAL ENTRE CASOS DE ARTRODESE CERVICAL E ARTROPLASTIA*

*ESTUDIO DE LA CAPACIDAD FUNCIONAL ENTRE CASOS DE ARTRODESIS CERVICAL Y ARTROPLASTIA*

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## ABSTRACT

**Introduction:** Cervical degenerative disc disease is a highly prevalent pathology in the general population, which can cause disability and high costs for the health system. Among the surgical modalities for treatment, cervical arthrodesis and cervical arthroplasty stand out. **Objective:** To compare the performance of surgical modalities of cervical arthrodesis and cervical arthroplasty in patients with degenerative cervical disc disease regarding quality of life and functional capacity. **Methodology:** Retrospective observation study, data analysis of information collected from medical records of patients undergoing arthrodesis and cervical arthroplasty, followed on an outpatient basis from 2015 to 2020. Functional capacity was assessed using the Oswestry Disability Index (ODI), and quality of life using the Short Form 36 Health Survey Questionnaire (SF-36) in the pre- and postoperative periods (06 months, 01 year, 02 years, 03 years, 04 years, and 05 years). Statistical significance was established with values of  $p \leq 0,05$ . **Results:** 122 patients were evaluated (56 in the arthrodesis group and 66 in the arthroplasty group). After the surgical interventions, individuals migrated from severe disability (50.8% / 54.3%) to minimal disability (15.3% / 9.0%). There was a decline in the ODI scores over the follow-up time ( $p \leq 0.001$ ) as well as in the SF-36 values ( $p \leq 0.001$ ) for both surgical techniques. Evaluating the difference in means revealed better performance of cervical arthroplasty ( $p \leq 0.001$ ). **Conclusion:** Considering the findings for functional capacity and quality of life, cervical arthroplasty performed better as a surgical technique for the treatment of degenerative cervical disc disease. **Level of Evidence IV; Retrospective, longitudinal, descriptive and observational study.**

**Keywords:** Arthrodesis; Arthroplasty; Neck Pain.

## RESUMO

**Introdução:** A doença degenerativa do disco cervical é uma patologia de alta prevalência na população geral, podendo causar incapacidade e altos custos para o sistema de saúde. **Dentre as modalidades cirúrgicas para tratamento, destacam-se a artrodese cervical e a artroplastia cervical. Objetivo:** Comparar o desempenho das modalidades cirúrgicas artrodese cervical e artroplastia cervical em pacientes portadores de discopatia degenerativa cervical em termos de qualidade de vida e capacidade funcional. **Metodologia:** Estudo observacional retrospectivo de análise de dados das informações colhidas em prontuários de pacientes submetidos à artrodese e artroplastia cervical, acompanhados ambulatorialmente no período de 2015 a 2020. **Foram avaliadas a capacidade funcional utilizando o Oswestry Disability Index (ODI) e a qualidade de vida através do Short Form 36 Health Survey Questionnaire (SF-36) nos períodos pré e pós-operatórios (06 meses, 01 ano, 02 anos, 03 anos, 04 anos e 05 anos). A significância estatística foi estabelecida com valores de  $p \leq 0,05$ . Resultados:** 122 pacientes foram avaliados (56 do grupo artrodese e 66 do grupo artroplastia). Após as intervenções cirúrgicas, os indivíduos migraram da incapacidade severa (50,8% / 54,3%) para incapacidade mínima (15,3% / 9,0%). Houve declínio nos escores do ODI ao longo do tempo de acompanhamento ( $p \leq 0,001$ ) assim como nos valores do SF-36 ( $p \leq 0,001$ ) para ambas técnicas cirúrgicas. **Conclusão:** Considerando os achados para capacidade funcional e qualidade de vida, a artroplastia cervical apresentou melhor desempenho enquanto técnica cirúrgica para tratamento da discopatia cervical degenerativa. **Nível de Evidência IV; Estudo retrospectivo, longitudinal, descritivo e observacional.**

**Descritores:** Artrodese; Artroplastia; Cervicalgia.

## RESUMEN

**Introducción:** La enfermedad degenerativa del disco cervical es una patología de alta prevalencia en la población general, que puede ocasionar discapacidad y altos costos para el sistema de salud. **Entre las modalidades quirúrgicas de tratamiento se destacan la artrodese cervical y la artroplastia cervical. Objetivo:** Comparar el desempeño de las modalidades quirúrgicas artrodese cervical y artroplastia cervical en pacientes con enfermedad discal cervical degenerativa en términos de calidad de vida y capacidad funcional. **Metodología:** Estudio

Study conducted by the city of São Paulo, SP, Brazil.

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observacional retrospectivo de análisis de datos de información recopilada de historias clínicas de pacientes sometidos a artrodesis y artroplastia cervical, seguidos de forma ambulatoria de 2015 a 2020. Se evaluó la capacidad funcional mediante el Oswestry Disability Index (ODI) y la calidad de vida mediante el Short Form 36 Health Survey Questionnaire (SF-36) en los períodos pre y postoperatorio (06 meses, 01 año, 02 años, 03 años, 04 años y 05 años). La significación estadística se estableció con valores de  $p \leq 0,05$ . Resultados: Se evaluaron 122 pacientes (56 en el grupo de artrodesis y 66 en el grupo de artroplastia). Después de las intervenciones quirúrgicas, los individuos migraron de discapacidad severa (50,8%/54,3%) a discapacidad mínima (15,3%/9,0%). Hubo una disminución en los puntajes del ODI a lo largo del tiempo de seguimiento ( $p \leq 0,001$ ) así como en los valores del SF-36 ( $p \leq 0,001$ ) para ambas técnicas quirúrgicas. La evaluación de la diferencia de medias reveló mejor desempeño de la artroplastia cervical ( $p \leq 0,001$ ). Conclusión: Considerando los hallazgos de capacidad funcional y calidad de vida, la artroplastia cervical se desempeñó mejor como técnica quirúrgica para el tratamiento de la enfermedad degenerativa del disco cervical. **Nivel de Evidencia IV; Estudio retrospectivo, longitudinal, descriptivo y observacional.**

**Descriptor:** Artrodesis; Artroplastia; Dolor de Cuello.

## INTRODUCTION

Cervicalgia is characterized by an acute or chronic pain syndrome that affects the cervical spine region. It is a common cause of pain in the general population, with a prevalence of around 10%, affecting 67% to 70% of adults at some point in their lives. The annual incidence in adults is 14.6%, with females having a higher likelihood of developing neck pain and suffering from persistent neck problems.<sup>1</sup>

The technological process and the use of devices such as computers and work overload are associated with an increase in cervical symptoms, having a high prevalence in body pain syndromes, making it the second leading cause of spinal pain. In the first place, there is pain of lumbar origin.<sup>2</sup>

As for the etiological classification, neck pain can result from mechanical-postural changes, arthrosis, hernias, disc protrusions, arthritis, spondylitis, or muscle spasms, causing various clinical repercussions.<sup>3</sup> Regarding the classification by time, it can be characterized as acute pain when it lasts less than 6 weeks, subacute when it lasts more than 6 weeks and less than 3 months, and chronic pain when it lasts more than 3 months.<sup>4</sup>

The etiology of neck pain associated with degenerative cervical disc disease can have its genesis in different conditions, such as disc herniation and spondylosis. The symptoms are manifested in the form of three painful syndromes: axial pain, radicular pain, myelopathy, or a combination of these three. The most frequent anatomical involvement occurs in the subaxial cervical spine from C3 to C7.<sup>5</sup>

They are more common in patients with neurological dysfunction, over 55 years of age, with male patients being more affected, in a ratio of 3:2. Patients who present with any of these pain syndromes after a compatible anamnesis and physical examination will be investigated through imaging studies to document their existence, describe their severity, and exclude differential diagnoses that may hinder the treatment of the disease.<sup>6</sup>

The treatment of cervical discopathies is multidisciplinary. It is necessary to follow up and monitor the patient on an outpatient basis, considering the severity of the clinical condition and the findings in imaging exams for therapeutic definition. The objectives of the treatment are to control pain, limit it in your daily life, and rehabilitate you for your work activities.<sup>7</sup> Initially, the treatment is conservative, resorting to surgical procedures when there is progressive neurological dysfunction, signs of medullary deterioration on imaging exams, persistent pain, and progressive muscle weakness or failure of conservative treatment for at least six months.

Among the surgical modalities, anterior cervical arthrodesis and cervical arthroplasty stand out.<sup>8</sup> Cervical arthrodesis is considered the gold standard technique in treating cervical disc diseases with radiculopathy and/or myelopathy, which despite excellent results in studies, causes earlier disc degeneration. Cervical arthroplasty with prosthesis placement is an option in treating cervical disc diseases, preserving the physiological kinematics of the cervical spine.<sup>9</sup>

In the technique considered the gold standard, a discectomy, and arthrodesis are performed via the anterior approach, where the space occupied by the disc is replaced by a bone block that leads

to the fusion of the two vertebrae in place of the intervertebral disc. This procedure has been successful over the years, remaining the main surgical option. Patients show clinical improvement in up to 90% of cases. Studies show that the fusion rate of arthrodesis for a single level is 92 to 100%.<sup>10</sup>

However, in multi-level discectomies, the fusion success rate decreases as the number of segments increases. Furthermore, complications such as pseudoarthrosis are responsible for 80% of surgical failures, and it is recommended that in long arthrodesis, stabilization with an anterior or posterior cervical plate be added to minimize this rate. The use of cervical plates is associated with the occurrence of complications, such as breakage, loosening of screws, esophageal injury, spinal cord or root injury due to poor positioning of implants, as well as prolonged surgical time and increased direct costs of the surgical procedure.<sup>11</sup>

Arthroplasty surgery consists of the artificial replacement of the intervertebral disc. Non-vertebral and facet joints allow for a wide range of movements while providing stability in the neck. The goal of cervical disc replacement is to remove the damaged disc while maintaining the cervical range of motion. The advantages of this technique compared to the conventional technique include maintaining normal neck movement, allowing early postoperative movement, reducing cervical degenerative disc disease of adjacent segments, reducing possible complications and problems associated with the need for a bone graft for spinal fusion, and the instrumentation used in arthrodesis.<sup>12</sup>

The indications for arthroplasty are similar to those for a discectomy and cervical arthrodesis, and its contraindications are diabetes, blood pressure changes, cholesterol, active infection, severe osteoporosis, advanced arthritis, or clinical or radiological evidence of instability that requires arthrodesis.<sup>13</sup>

Studies indicate that surgical treatment improves neurological dysfunction, functional capacity, and quality of life in patients with cervical disc disease. Furthermore, degenerative disc diseases can cause disability and high costs for the healthcare system. However, unlike chronic nonspecific low back pain, there are still few studies that support the use of the various surgical therapeutic modalities employed.<sup>14</sup> In this sense, the study aimed to compare the performance of the surgical modalities cervical arthrodesis and cervical arthroplasty in patients with cervical degenerative disc disease regarding quality of life and functional capacity.

## METHODS

This is an observational, cross-sectional study with data collected retrospectively through analyzing 200 medical records of patients undergoing orthopedic treatments with a spine surgery specialist in outpatient clinics in services provided in the state of São Paulo.

The inclusion criteria for patient records were those over 18 years old who had cervicalgia and underwent cervical arthrodesis and arthroplasty surgery. For exclusion criteria, a pre-selection of patients who have not had outpatient follow-up for more than 12 months was used, as well as imaging exams (cervical X-ray AP/P, cervical X-ray AP/P with flexion and extension, Cervical CT, Cervical

MRI, and Electroneuromyography of the upper limbs) according to the required periodicity for follow-up and progress of postoperative recovery. We evaluated the general characteristics of the patients, such as age, sex, lifestyle habits, comorbidities, frequent examinations, and periodic treatment for postoperative control and evolution.

Information obtained from a database monitoring the evolution of postoperative progress through information obtained with the applicability of the Short Form 36 Health Survey Questionnaire (SF-36) and Oswestry Disability Index (ODI) questionnaires in the predetermined periods of pre and postoperative follow-ups (preoperative, 6 months, 1 year, 2 years, 3 years, 4 years, and 5 years) between 01/01/2015 to 07/30/2020.

The ODI consists of an instrument for functional evaluation of the spine, composed of items that represent different aspects of health. The total ODI score is presented in percentages, where lower values are attributed to better functionality: minimal disability (0 – 20%), moderate disability (21 – 40%), severe disability (41 – 60%), disability (61 – 80%), bedridden or overestimating your symptoms (81 – 100%).<sup>15</sup>

The SF-36 is used to assess quality of life. It contains items measured by eight domains: Functional Capacity (FC), Limitation by Physical Aspects (LPA), Pain (PAIN), General Health Status (GHS), Vitality (VIT), Social Aspects (SA), Limitation by Emotional Aspects (LEA), and Mental Health (MH). Higher scores are associated with better health status.<sup>16</sup>

The data was tabulated in a Microsoft Office Excel 2013 spreadsheet. The Statistical Package for the Social Sciences 25.0 was used to perform the corresponding statistical analyses: evaluation of means and standard deviation for ODI and SF-36 scores, as well as the normality test of data distribution by the Shapiro-Wilk method. Obtaining statistical significance measures in terms of values and  $p \leq 0.05$  at all observation times, including for the evaluation of paired samples, was performed using the Student's T-test for normally distributed variables. Given the non-normality of the distribution, the Wilcoxon test was used.

The research project was submitted to the Ethics and Research Committee of the University Center of the ABC School of Medicine and approved under CAAE registration: 67251123.9.0000.0082

**RESULTS**

Data were obtained from 122 patients, of which 56 underwent cervical arthrodesis (group I) and 66 underwent cervical arthroplasty (group II), with general and complementary information according to the general classification information spreadsheet. (Table 1)

The gender of the participants was predominantly female (58.9% in group I and 52.8% in group II). At the end of the 5 years of follow-up, it was noticed that the patients migrated from the classification of severe disability to minimal disability in both the arthrodesis group (50.8% – 15.3%) and the arthroplasty group (54.3% – 9.0%). A large

portion of the individuals studied had an average age range between 30 to 50 years old. In group I of Arthrodesis, the predominant age range was patients aged 50 and above or those with extremely complex segmental instability. In group II – Arthroplasty, the predominant age range was between 30 and 48 years old, with most patients having pathology in 1 or 2 diseased segments.

Considering the comorbidities studied, a significant number of 85% of the patients studied had pathologies such as: Diabetes, altered blood pressure or cholesterol, as the vast majority with these comorbidities had them under control and were being monitored by specialists for maintenance, as these are comorbidities that require attention and care but do not directly interfere with a negative application of the techniques in question. Patients who had comorbidities associated with bone pathologies, after conducting a more in-depth study with specialized exams (Rheumatic Tests and Bone Scintigraphy), in severe cases, patients were advised to undergo specific treatment with calcium supplementation, and after the determined period of specific treatment and reanalysis of the specific exams, they were suitable for specific groups (arthrodesis and/or arthroplasty), a number that does not reach 2% of the studied patients. However, even though the number is small, this comorbidity is of fundamental importance to be analyzed, as studies have already pointed out breaks or loosening of the implanted material due to the patient's bone mass quality deficit, which can and does lead to major aggravations and complications with the technique performed, consequently worsening the patient's overall quality of life both in the short and long term, and may even lead to the need for the removal of the implanted technique.

The evaluation of the differences in the averages allowed to highlight the maintenance of the results over time, with better performance for the cervical arthroplasty technique. (Table 2)

The findings of the ODI values for the evaluated techniques showed a consistent decrease in the score values over the follow-up period, of which cervical arthroplasty had the greatest impact on the decrease, but with statistical significance only in the 01-year postoperative period ( $p < 0.04$ ). (Figure 1)

Regarding the findings of the SF-36 for the Cervical Arthrodesis technique, an increasing average was observed for the investigated domains. Considering the difference in values between the pre-operative and the end of follow-up, more significant gains were identified for PAIN, with statistical significance ( $p = 0.003$ ). At the end of the follow-up period, a decrease in score values was observed for all dimensions. (Figure 2)

For the Cervical Arthroplasty technique, considering the start and end values of the follow-up, it was observed that the average increased for all SF-36 domains, with emphasis on FC, a statistically significant finding ( $p = 0.01$ ). (Figure 3) At 05 post-operative years, there was a reduction in the scores of the LAF, GHS, and AS domains. (Figure 3)

The comparison of SF-36 means over the follow-up periods

**Table 1.** General classificatory information.

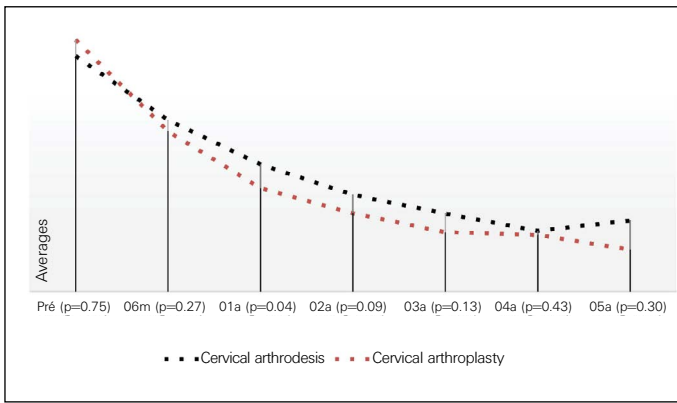
Groups	Age				Sex		Comorbidities			
	Less than 30	30 to 40 years	40 to 50 years	over 50 years	Feminine	Masculine	Diabetes	Blood Pressure	Cholesterol	Bone Diseases
I - Arthrodesis										
II - Arthroplasty										

Table model created to obtain general classification information for obtaining statistical data and case study.

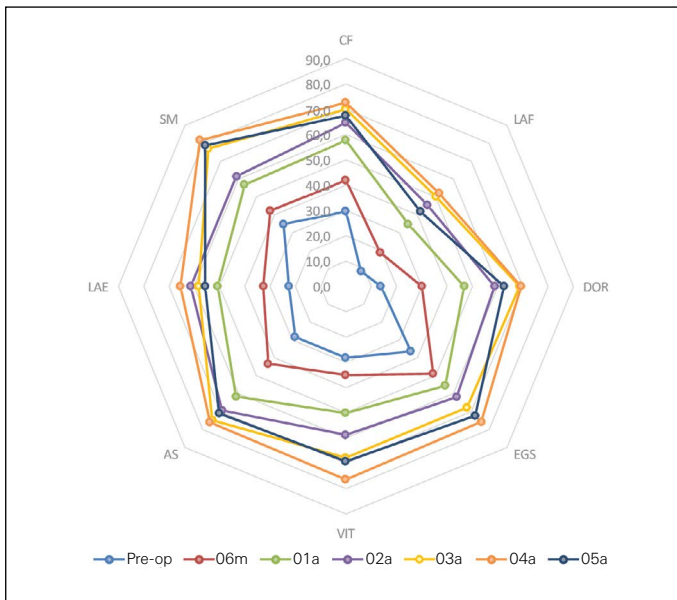
**Table 2.** Comparison of mean differences for ODI values for follow-up times according to surgical techniques.

Surgical technique	Oswestry Disability Index													
	Pre- operative		06 months		01 year		02 years		03 years		04 years		05 years	
	I <sup>§</sup> (n=56)	II <sup>#</sup> (n=66)	I (n=52)	II (n=63)	I (n=52)	II (n=57)	I (n=50)	II (n=48)	I (n=42)	II (n=27)	I (n=22)	II (n=13)	I (n=12)	II (n=04)
Average	50.8	54.3	37.0	34.6	27.4	22.3	20.9	16.9	16.8	12.8	13.1	12.2	15.3	9.0
DP <sup>§</sup>	23.1	21.2	20.6	15.7	14.7	11.9	12.7	12.2	13.5	11.5	15.4	10.6	15.4	4.2
DM <sup>#</sup>	-3.5		2.4		5.1		4.0		4.0		0.9		6.3	

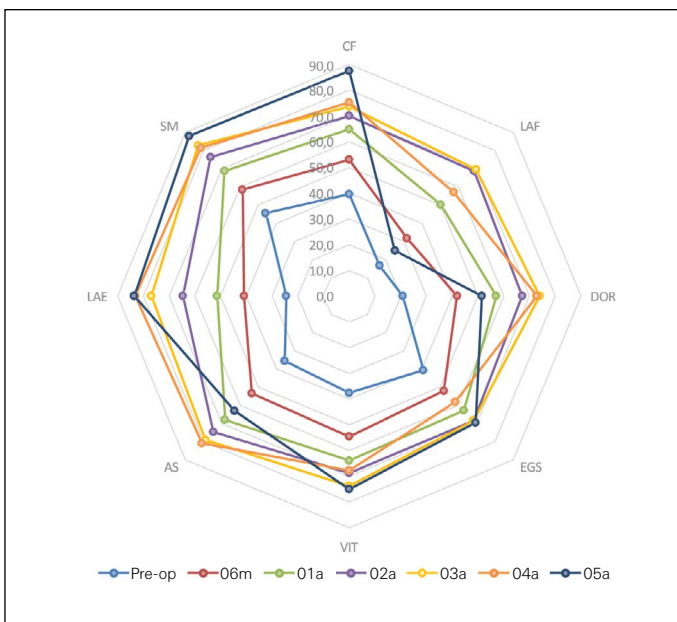
<sup>§</sup>Group I = cervical arthrodesis <sup>#</sup>Group II = cervical arthroplasty. <sup>§</sup>Standard deviation. Difference of means = mean group I – mean group II.



**Figure 1.** ODI values for follow-up times according to surgical techniques.



**Figure 2.** SF-36 values for follow-up times according to the surgical technique of Cervical arthrodesis.



**Figure 3.** SF-36 values for follow-up times according to the surgical technique Cervical arthroplasty.

showed that cervical arthroplasty was superior to arthrodesis for most of the investigated domains. Considering the established statistical significance, arthroplasty showed superiority mainly for the LAF, VIT, and PAIN dimensions. The magnitude of the results for the 08 domains of the SF-36 indicated cervical arthroplasty as the technique that provided the greatest benefit for the patients especially up to 01-year post-operative. After this period, no superiority of one technique over the other was established. (Table 3)

## DISCUSSION

In the present study, it was pointed out that degenerative pathologies of the cervical spine can cause debilitating symptoms. The prevalence of neck pain was estimated at almost 67% of people, with a point prevalence of 22%. Although the emphasis on financial and social burdens has been attributed to low back pain, the disability caused by neck pain can also impose a substantial financial burden, as well as a negative impact on the lives of those affected.<sup>17</sup>

Our study retrospectively evaluated data from 122 patients with degenerative disc disease who underwent cervical arthrodesis or arthroplasty at 07 different times: preoperative, 06 months, 01 years, 02 years, 03 years, 04 years, and 05 years postoperative. After the establishment of surgical techniques, it was possible to observe

**Table 3.** Analysis of the mean difference of the SF-36 for the follow-up periods.

Periods	SF-36	DM <sup>#</sup>	p
06 months post-operative	FC	-11.10	0.032*
	LPA	-12.76	0.044*
	PAIN	-11.94	0.004*
	GHS	-3.20	0.241
	VIT	-19.63	<0.001*
	SA	-10.22	0.026*
	LEA	-8.14	0.190
	MH	-16.18	<0.001*
01-year post-operative	FC	-7.13	0.089
	LPA	-15.44	0.042*
	PAIN	-10.46	0.012*
	GHS	-7.48	0.052*
	VIT	-13.78	<0.001*
	SA	-6.60	0.078
	LEA	-0.60	0.473
	MH	-11.95	0.003*
02 years post-operative	FC	-5.40	0.120
	LPA	-22.99	0.003*
	PAIN	-8.46	0.054*
	GHS	-6.52	0.050*
	VIT	-10.10	0.006*
	SA	-5.27	0.140
	LEA	-3.21	0.359
	MH	-5.40	0.120
03 years post-operative	FC	-3.43	0.299
	LPA	-19.28	0.038*
	PAIN	-5.33	0.184
	GHS	-0.71	0.447
	VIT	-6.03	0.092
	SA	-4.22	0.243
	LEA	-18.56	0.043*
	MH	-5.98	0.101
04 years post-operative	FC	-2.67	0.391
	LPA	-5.13	0.380
	PAIN	-3.72	0.333
	GHS	17.49	0.997
	VIT	8.59	0.868
	SA	-4.84	0.289
	LEA	-17.53	0.108
	MH	0.09	0.506
05-years post-operative	FC	-20.00	0.212
	LPA	16.67	0.660
	PAIN	11.00	0.679
	GHS	2.67	0.558
	VIT	-5.83	0.363
	SA	8.00	0.669
	LEA	-27.83	0.227
	MH	-9.33	0.248

<sup>#</sup>Difference of means = arthrodesis mean - arthroplasty mean. Statistically significant.

good clinical progress in patients from both groups, who moved from the classification of severe disability to minimal disability. It was also noticed, regardless of the surgical technique used, an improvement in quality-of-life indicators with the superiority of the cervical arthroplasty technique, especially up to 01-year post-operative significant numbers.

The restoration of functional capacity was evident by the decrease in ODI values, with a reduction of 35.5 points in the arthrodesis group and 45.3 points in the arthroplasty group at the end of the 5-year follow-up. The specialized literature indicates that reductions above 18.8 in the ODI score are considered significant gains for patients classified as highly disabled in the pre-surgical period.<sup>18</sup>

Chambers, Kropp, and Gardocki,<sup>19</sup> in a retrospective study conducted with 116 patients undergoing cervical arthrodesis, found a reduction of 12 points in the ODI at 2 years postoperatively, a figure lower than our findings which in this period of follow-up already showed a reduction of 29.9 points. In a recent meta-analysis, the comparison of functional capacity between patients undergoing cervical arthrodesis and arthroplasty found the latter to be superior, corroborating the results of the present study.<sup>20</sup>

About the SF-36, the data showed that patients who underwent arthroplasty scored higher than those who underwent arthrodesis. This superiority became evident in the short term, since at {02} years postoperatively this was not statistically significant, findings consistent with the literature (21,22). An explanation for such a finding would be the possible limitation of the SF-36 in detecting any impairments in the upper extremities.<sup>20</sup>

In the specialized literature,<sup>21-25</sup> the evaluation of the surgical techniques of arthrodesis and cervical arthroplasty show positive results in clinical improvement, functional capacity, and quality of life, however, without significant difference in the latest long-term follow-up periods, data similar to our findings. In this regard, it is considered that there is no current consensus on the use of arthrodesis or arthroplasty in patients with degenerative cervical disease (23–25). Studies also point to a follow-up loss of over 22% as an aspect that interferes with the inference of results related to spine surgery.<sup>26</sup>

The evaluation of results after orthopedic surgical procedures based on patient experience has been currently accepted as less biased and more relevant. Several instruments are available, including aspects of disease perception, health, and patient satisfaction. In this context, the assessment of quality of life and functional capacity offers the advantage of comparing improvement after the implementation of different treatments in a biopsychosocial context.<sup>27</sup>

This study has limitations that should be highlighted. The number of patients who made up the sample in the last follow-up period was less than half of those who started, which may constitute a selection bias. Furthermore, the patients were not randomly allocated by surgical technique group. In this regard, it is worth noting that the selection of patients for each surgical technique was carefully selected, based on well-established clinical criteria.

Although we compared patients undergoing different surgical techniques, all were approached by a single surgeon using standardized techniques who did not participate in the data collection and analysis, thus being free from influence on the results found. The use of more than one instrument to assess surgical outcome measures and the conduct of relevant statistical treatments ensures the confirmation of this study's results.

## CONCLUSION

The study presented evidence that cervical arthroplasty showed a better clinical success rate regarding functional capacity and quality of life, especially one year after the surgical procedure. We can affirm that it has an important correlation with the time needed for the applied techniques to achieve good "implant-bone" integration. This brings greater confidence to the patient for physical and physiotherapeutic rehabilitation, thus providing better functional and emotional quality of life day by day.

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All authors declare no potential conflict of interest related to this article.

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