RESULTS OF DISC ARTHROPLASTY FOR THE TREATMENT OF CERVICAL DISC HERNIATION

RESULTADOS DA ARTROPLASTIA DE DISCO NO TRATAMENTO DA HÉRNIA DISCAL CERVICAL

RESULTADOS DE LA ARTROPLASTIA DE DISCO EN EL TRATAMIENTO DE LA HERNIA DISCAL CERVICAL

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ABSTRACT

Objective: Evaluation of long-term results of cervical disc arthroplasty (CDA) and comparison with fusion in the treatment of disc herniation. Methods: Patients with cervical radiculopathy due to single level disc herniation submitted to CDA between June 2003 and July 2006 (arthroplasty group). Clinical and radiographic evaluation was performed preoperatively, after one year and at least five years after the procedure. A fusion group, who underwent anterior decompression and fusion in the same period, was used as control and was evaluated at final follow-up. Results: 22 patients in the arthroplasty group and 12 in the fusion group, with mean follow-up of 5.4 years. In the first evaluation we obtained an average mobility of 8.8° (range 2.2°-22°), and this decreased on average 3.6° (range-18°-3.8°) to the final date of follow-up. At the time of final follow-up, 28% of patients who initially underwent arthroplasty lost the desired mobility; the NDI was 21% in the arthroplasty group *vs* 36.5% in the fusion group (p=0.008); there was a tendency for a lower cervical (2.9 *vs* 4.6) and arm VAS (2.8 *vs* 4.9) in the arthroplasty group (p>0.05). There were no statistically significant differences between the two arthroplasties used with respect to mobility, functional scores, or complications. All patients in the arthroplasty group would repeat the procedure in comparison to only 67% of the fusion group (p=0.021). Conclusions: Both techniques proved to be effective in the treatment of cervical disc herniation. The loss of mobility was not clinically significant.The arthroplasty group showed slightly superior results in the functional outcomes.

Keywords: Spine; Intervertebral disc displacement; Spondylosis; Spinal fusion; Arthroplasty.

RESUMO

Objetivo: Avaliação dos resultados a longo prazo da artroplastia de disco cervical (ADC) e comparação com fusão no tratamento da hérnia discal. Métodos: Seleccionados pacientes com radiculopatia por hérnia discal cervical a um nível sucessivamente submetidos a ADC entre Junho de 2003 e Julho de 2006 (grupo artroplastia). Realizada avaliação radiográfica e clínica no pré-operatório, ao fim de um ano, e pelo menos cinco anos após o procedimento. Como controlo foi utilizado grupo submetido a descompressão e artrodese anterior, operado no mesmo período (grupo fusão), avaliado no tempo final de seguimento. Resultados: 22 pacientes do grupo artroplastia e 12 do grupo fusão, com tempo de seguimento médio de 5.4 anos. Na primeira avaliação obteve-se uma mobilidade média de 8,8º (2,2º-22º), tendo esta diminuído em média 3,6º (-18º-3,8º) à data final de seguimento. À data de seguimento final, 28% dos doentes inicialmente submetidos a artroplastia perderam a mobilidade pretendida; o NDI foi de 21% no grupo artroplastia vs 36,5% no grupo fusão (p=0,008); registou-se tendência para EVA cervical (2,9 vs 4,6) e braquial (2,8 vs 4,9) mais baixo no grupo artroplastia (p>0,05). Não se verificaram diferenças estatisticamente significativas entre as duas artroplastias utilizadas no que respeita a mobilidade, scores funcionais, ou complicações. Todos os pacientes do grupo artroplastia repetiriam o procedimento para apenas 67% do grupo fusão (p=0,021). Conclusões: Ambas as técnicas demonstraram ser seguras e eficazes no tratamento da hérnia discal cervical. A perda da mobilidade não teve repercussão clínica. O grupo artroplastia demonstrou ligeira superioridade nos resultados funcionais.

Descritores: Coluna vertebral; Deslocamento do disco intervertebral; Espondilose; Fusão vertebral; Artroplastia.

RESUMEN

Objetivo: Evaluación de los resultados a largo plazo de la artroplastia de disco cervical (ADC) y comparación con la fusión en el tratamiento de la hernia discal. Métodos: Seleccionados pacientes con radiculopatía por hernia discal cervical a un nivel, sometidos sucesivamente a ADC entre junio de 2003 y julio de 2006 (grupo de artroplastia). Realizadas evaluaciones radiográfica y clínica en el preoperatorio, al fin de un año y por lo menos cinco años después del procedimiento. Como control, se consideró a un grupo sometido a descompresión y artrodesis anterior, operado en el mismo período (grupo de fusión), evaluado en el período final de seguimiento. Resultados: 22 pacientes del grupo de artroplastia y 12 del grupo de fusión, con período promedio de seguimiento de 5,4 años. En la primera evaluación, se obtuvo una movilidad promedio de 8,8º (2,2º-22º), habiendo esta disminuido en promedio 3,6º (-18º-3,8º) a la fecha final del acompañamiento. En la fecha final del seguimiento, 28% de los enfermos, sometidos inicialmente a artroplastia, habían perdido la movilidad pretendida; el NDI fue 21% en el grupo de artroplastia vs 36,5% en el grupo de fusión (p=0,008); se registró tendencia para EVA cervical (2,9 vs 4,6) y braquial (2,8 vs 4,9) más bajo en el grupo de artroplastia (p>0,05). No se verificaron diferencias estadísticamente significativas entre las dos artroplastias que se utilizaron, con respecto a movilidad, scores funcionales o complicaciones. Todos los pacientes del grupo de artroplastia repitieron el procedimiento, en comparación con solamente 67% del grupo de fusión (p=0,021). Conclusiones: Ambas técnicas demostraron ser seguras y eficaces en el tratamiento de la hernia discal cervical. La pérdida de la movilidad no tuvo repercusión clínica. El grupo de artroplastia demostró una ligera superioridad en los resultados funcionales.

Descriptores: Columna vertebral; Desplazamiento del disco intervertebral; Espondilosis; Fusión vertebral; Artroplastia.

INTRODUCTION

Anterior cervical discectomy and arthrodesis has been a successful procedure that is predictive of good clinical and radiological results, resulting in high patient satisfaction.[1-5] Its purpose is the decompression of neural elements, the permanent stabilization of the segment, and the maintenance of lordosis and of the height of the disk space.[6]

However, biomechanical cadaveric studies have shown that

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there is an increase in intradiscal pressure after anterior cervical discectomy and arthrodesis[7], with subsequent increased mobility of adjacent segments[8,9] leading to a potential acceleration of degenerative disc disease.[10,11]

There were reports in the literature that although fusion is excellent for the level affected, it is likely harmful to the remaining mobile segments.[12,13]

Cervical disc arthroplasty (CDA) has proven itself to be an alternative to fusion in degenerative disc disease. In addition to nerve decompression and restoration of the interbody height and spinal alignment, preservation of mobility can potentially decrease the likelihood of a diseased adjacent segment.[1,14,15]

It also avoids the morbidity inherent in fusion, such as nonunion, collapse and/or migration of the bone graft.[16]

The aim of this study is to evaluate the long-term results of CDA in the treatment of cervical disc herniation with radiculopathy and compare its clinical results with the control group, which underwent fusion.

MATERIALS AND METHODS

We conducted a retrospective study of patients who underwent surgery between June 2003 and January 2006.

Inclusion criteria for the study consisted of skeletally mature patients: 1) that had cervical radiculopathy, 2) with imaging evidence of nerve root compression by cervical disc herniation at one level, 3) with failure of conservative treatment, and 4) who were treated surgically by cervical disc arthroplasty or interbody arthrodesis.

Exclusion criteria were: presence of myelopathy, narrow cervical canal, severe facet and uncovertebral arthrosis, segmental kyphosis, previous surgery, or ossification of the posterior longitudinal ligament.

The surgical technique consisted of decompression of neural elements by an anterior approach, followed by arthroplasty (Bryan™ or Prestige™ implants, Medtronic), or interbody fusion with a cervical cage and autologous iliac crest graft.

In the group that underwent CDA, clinical and radiographic evaluations were conducted preoperatively, one year after surgery, and at least five years after surgery.

In the group undergoing fusion, clinical and radiographic evaluations were performed at the end of follow-up, with a minimum follow-up period of five years.

In the clinical evaluation, we used the Neck Disability Index (NDI, 0-100%), the visual analogue scale (VAS) for pain assessment, the subjective functional outcome (excellent, good, poor or bad), and whether the patient would recommend/repeat the procedure.

Radiographic follow-up was based on radiographs of the cervical spine in the frontal and profile views, complete with dynamic lateral x-rays in flexion/extension with measurement of segmental motion according to the Cobb angle.

Statistical analysis was performed using SPSS 17.0 (Fisher's exact test, Mann-Whitney and t-test). Statistical significance was set at $p \leq 0.05$. The homogeneity of the sample was evaluated by Levene's test.

RESULTS

Thirty-four patients were selected. Of the 22 patients in the arthroplasty group (eight Bryan™ and 14 Prestige™ implants), six were male and 16 were female. Of the 12 patients in the fusion group, five were male and seven were female.

At the time of surgery, the average age in the arthroplasty group was 40 years (26-51), while that the fusion group was 44 (32-55). Follow-up was on average 5.4 years (5-7). The homogeneity of the sample with respect to age and follow-up duration was confirmed.

The level most frequently affected was C5-C6 (68% of the arthroplasty group vs. 83% of the fusion group), followed by C6-C7 (32% of the arthroplasty group vs. 8% of the fusion group) and C4-C5 (8% of the fusion group).

At one year follow-up, we obtained an average mobility of 8.8° (2.2°-22°), and this decreased 3.6° (-18°-3.8°) on average by the final follow-up date. (Table 1)

There was no nonunion in the fusion group.

The complications consisted of one patient progressing to heterotopic ossification with total loss of mobility during the first year of follow-up, and two patients converting to fusion, one by persistent brachialgia in the immediate postoperative period which required revision surgery with decompression, and another for persistent axial pain.

At the end of follow-up there was a loss of total mobility in 17% of the Bryan™ arthroplasties and in 18% of the Prestige™ arthroplasties.

Table 1. Average mobility of the arthroplasty group.

	1 year follow-up	5 years follow-up	Final ROM loss
Bryan arthroplasty	9.8° (3.6 – 15)	6.7° (0 – 10.9)	4.5° (-3.8 – 11.4)
Prestige arthroplasty	8.1° (0 – 22)	4.5° (0 – 10.5)	3.1° (-1.6 – 18)
Total average	8.8°	5.2°	3.6°

Clinical evaluation

In the arthroplasty group, the initial NDI and the NDI after one year of follow-up was on average 72% and 18.5%, respectively. At the time of the final follow-up visit, it was 21% in patients who had undergone arthroplasty vs. 36.5% in patients who had undergone fusion ($p = 0.008$).

Despite the tendency for a lower cervical (2.9 *vs*. 4.6) and arm (2.8 *vs*. 4.9) VAS score in the arthroplasty group, the difference was not statistically significant.

There were no statistically significant differences between the two arthroplasty procedures used as regards mobility, functional scores, or complications.

There were no statistically significant differences in the degree of subjective satisfaction (Figure 1) or in the number of patients who would recommend the procedure (100% of the arthroplasty group *vs*. 75% of the fusion group). All of the patients in the arthroplasty group would repeat the procedure, whereas only 67% of the fusion group would ($p = 0.021$).

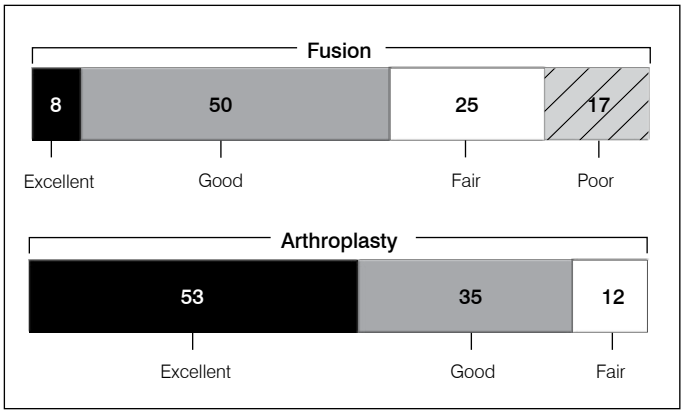

Figure 1. Subjective assessment of the degree of satisfaction at the final follow-up visit (%).

DISCUSSION

In the classic study by Hilibrand et al.,[13] adjacent segment disease (ASD) occurred at a rate of 2.9%/year in patients undergoing fusion, and would therefore affect more than 25% of operated patients after 10 years. The author admits, however, that the ASD can only correspond to the natural evolution of the disease as a reflection of the progression of cervical spondylosis.

Given that the main objective of cervical disc arthroplasty is the preservation of segmental mobility to prevent adjacent segment disease, there is, interestingly, according to Maldonado et al.,[6] an absence of prospective randomized trials in which ASD has been considered a main outcome criterion.

Thus, the role of arthroplasty in preventing ASD remains poorly understood, awaiting for level I evidence studies regarding the superiority of arthroplasty over fusion to be completed.[6]

In our study, the mean postoperative mobilities after arthroplasty correspond to those described in the literature.[17] However, at the final date of follow-up, 28% of the patients who initially underwent arthroplasty lost their desired mobility, a factor that had no clinical significance. We believe that the data analysis performed does not allow us to delve further into the reasons for the loss of mobility encountered, to characterize the degree of heterotopic ossification, or support any causal relationship with incipient signs of instability or minimal osteophytosis that may have existed prior to surgery.

Sola et al.[18] found 60% fusion at five years follow-up after Bryan™ arthroplasty, and Suchomel et al.[19], four years after ProDiscC™ arthroplasty, found evidence of the presence of significant heterotopic ossification in 45% of patients, and segmental ankylosis in 18% of patients. There is increasing evidence in the literature that, as evidenced in our study, heterotopic ossification does not show itself to be relevant regarding the absence of clinical deterioration.[20,21]

A key issue in the process of choosing the implant after decompression is whether the use of a more sophisticated but proportionally more expensive mobile implant is justified to preserve mobility and prevent overloading of the adjacent segment, the consequences of which are already known, if with a follow-up of over four years, a significant percentage of patients will lose segmental mobility and consequently, the "protective effect" potentially conferred by arthroplasty. To Suchomel et al.,[19] this finding is a strong argument against the theory of the protection of the adjacent segment.

Although a five-year period is sufficient to draw conclusions on the success of a fusion surgery, for an arthroplasty this represents a short follow-up period, and it was not yet possible to determine the rate of implant failure or if it fulfilled the role of protecting adjacent levels. Identifying the presence of ASD in the fusion group was not an object of this study.

According to Anderson et al.[22] and Cleland et al.,[23] in order for a difference in the NDI and VAS to reach clinical significance between groups, it would have to be 15-19 for the NDI and 1.3-2 for the VAS. The values found in our study as well as those revealed in similar comparative studies, reflect a slight statistical superiority of arthroplasty over fusion in functional results, with an average difference of 2-7 in the NDI and 0.6-1.5 in the VAS,[16,24,25] which is insufficient to translate to clinically significant superiority of one group over another.

Our study also showed a trend towards a higher degree of subjective satisfaction of the patients in the arthroplasty group, though with no statistically significant difference from the fusion group. Although care was taken to check the homogeneity of the sample between the two groups with regard to age and duration of follow-up, we have no robust clinical data on the preoperative status of the fusion group, which is a limitation of this retrospective study. The strict selection criteria of patients eligible for arthroplasty (generally younger patients with fewer comorbidities, lower extent of degenerative disease, fewer affected segments) may condition this group *a priori* to a more favorable outcome.[26] The expectation of and perspective for clinical improvement of the patient who knows he/she will undergo the latest and "most scientifically advanced" surgical technique for the treatment of their disease may favor their assessment of the global outcome and ultimate satisfaction in comparison to the patient that was operated by the old technique.[26]

We did not find statistically significant differences between the implants used in relation to mobility, functional scores, and complications; however, it is difficult to draw definitive conclusions given the small sample size.

CONCLUSION

According to the results, both fusion and arthroplasty are shown to be safe and effective in the treatment of cervical disc herniation. Despite there being increasing concern after cervical disc arthroplasty, no evidence of material wear was identified and loss of the mobility obtained had no clinical consequences. The clinical results obtained are good and are maintained over time.

All authors declare no potential conflict of interest concerning this article.

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