

Revista Española de Cirugía Ortopédica y Traumatología

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ORIGINAL PAPERS

Comparison of three-level anterior cervical discectomy and fusion using iliac crest bone graft and plate vs interbody cages with allograft and plate

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Received: 17 May 2009; accepted: 21 June 2009
Available online: 21 October 2009

KEYWORDS

Cervical disc disease;
Cervical fusion;
Allograft

Abstract

Anterior cervical plate fixation is believed to stabilize the operative motion segments, decreasing graft migration and preventing graft collapse that could lead to loss of cervical lordosis, malunion or nonunion and neurologic compromise. Although reports have noted high fusion rates in plated multilevel anterior cervical discectomy and fusion (ACDF) that range from 47% to 100% and are dependent on the number of levels fused, the efficacy of the combination of a titanium cage with allograft in comparison with autograft in such patients has not been investigated.

We retrospectively analyzed 36 cases of three-level ACDF with anterior semi rigid plating. All cases were performed between August 2000 and June 2005. There were 19 males and 17 females with an average age of 51.6 (range from 35 to 69). Operated levels were C4-C7 in 30 patients, C3-C6 in 5 and C5-T1 in one patient. Nineteen patients (52%) had autologous iliac crest tricortical grafts, 17 (47%) had PEEK cages placed filled with allografts.

The technique was the same in all cases: a standard left anteromedial approach to the cervical spine. The intervertebral discs were removed. All patients had burring of the end plates, 2 mm distraction and countersinking of the grafts by 2 mm from the anterior vertebral border. The autologous bone graft was tricortical and was harvested from the iliac crest using a low speed oscillating saw. The allograft used was fresh frozen, vacuum sealed cancellous chips and putty. An anterior cervical titanium plate was selected with variable angle locked screws. Clinical and radiographic data at 1 and 2 years post operatively were obtained. Clinical outcome was assessed on 1 and 2 year follow-up and rated according to the Odom criteria. Fusion was achieved in 18 (94%) of the iliac crest group and 12 (71%) of the PEEK cage-allograft group. 1 patient in the iliac crest group and 5 in the cage-allograft group developed nonunions. Clinical outcome at 2 years was excellent

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in 5, good in 12 and fair in 2 patients of the iliac crest group. On the cage-allograft group it was excellent in 3, good in 13 and fair in 1. The 5 nonunions had good clinical outcome and 1 fair. We concluded that although autograft is the gold standard for 3 level ACDF, the use of allograft has the same functional status irrespective of the higher number of pseudarthrosis. The decision to use an autograft or a cage and an allograft for ACDF is therefore based mainly on personal preferences.

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PALABRAS CLAVE

Enfermedad degenerativa discal;
Artrodesis cervical;
Aloinjerto

Discectomía y fusión cervical anterior a tres niveles con auto y aloinjerto

Resumen

Se considera que la osteosíntesis con placa de la columna cervical anterior es capaz de estabilizar los segmentos afectados, reduce al mismo tiempo la migración de los injertos e impide el colapso de éstos, que podrían provocar una pérdida de lordosis, así como callos viciosos, pseudoartrosis y alteraciones neurológicas. Aunque se han publicado tasas de fusión elevadas en discectomías y artrodesis cervicales anteriores multinivel realizadas con placa, con índices que oscilan entre el 47 y el 100% dependiendo del número de niveles operados, no existen en la bibliografía científica estudios que comparen la eficacia del tratamiento con cajetín de titanio más aloinjerto con el tratamiento con autoinjerto en estos pacientes.

En este estudio hemos analizado de forma retrospectiva 36 casos de discectomía y artrodesis cervical anterior operados con placa semirrígida a 3 niveles. Se intervino a todos los pacientes entre agosto de 2000 y junio de 2005. El grupo de estudio estaba compuesto por 19 hombres y 17 mujeres, con una media de edad de 51,6 años (rango: 35-69). Los niveles operados fueron C4-C7 en 30 pacientes, C3-C6 en 5 y C5-T1 en un paciente. En 19 pacientes (52%) se utilizaron injertos autólogos tricorticales de cresta ilíaca y en 17 pacientes (47%) se optó por cajetines de PEEK (polietercetona) rellenos de aloinjerto.

En todos los casos se utilizó un acceso anteromedial a la columna cervical. Se extirparon los discos intervertebrales. En todos los pacientes se fresaron los platillos vertebrales y se procedió a la distracción del segmento móvil en 2 mm y al avellanado de los injertos a 2 mm del borde anterior de la vértebra. El injerto autógeno tricortical utilizado se obtuvo de la cresta ilíaca por medio de una sierra oscilante de baja velocidad. Se utilizó aloinjerto fresco-congelado, virutas de hueso esponjoso envasadas al vacío y pasta de hueso. Se seleccionó una placa cervical de titanio con tornillos de bloqueo de ángulo variable. Se recogieron datos de los pacientes a uno y 2 años de evolución. Se realizó valoración del resultado clínico, transcurridos uno y 2 años de la cirugía según la escala de Odom. La fusión se consiguió en 18 pacientes (94%) del grupo de cresta ilíaca y en 12 pacientes (71%) del grupo de cajetín de PEEK-aloinjerto. Un paciente del grupo de cresta ilíaca y 5 pacientes del grupo cajetín-aloinjerto presentaron pseudoartrosis. El resultado clínico al cabo de 2 años fue excelente en 5 pacientes, bueno en 12 pacientes y regular en 2 pacientes del grupo de cresta ilíaca. En el grupo cajetín-aloinjerto, el resultado fue excelente en 3 pacientes, bueno en 13 pacientes y regular en un paciente. Cinco casos de pseudoartrosis evolucionaron bien y un caso evolucionó regular. Como conclusión, podemos afirmar que aunque la colocación de autoinjerto es el patrón de oro para discectomías y artrodesis cervicales anteriores a 3 niveles, el uso de aloinjertos consigue el mismo resultado funcional, independientemente de un mayor número de pseudoartrosis. Por tanto, la decisión de utilizar autoinjerto o cajetín protésico está basada principalmente en preferencias personales.

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Introduction

Anterior cervical discectomy and fusion is a common procedure for the decompression of the cervical neural

elements in various types of cervical spine pathologies like degenerative diseases, trauma and tumours. They were first reported by Robinson and Smith in 1955¹. For a good outcome in ACDF bony fusion is necessary. Fusion is affected by

systemic factors, operative technique, plate type and type of graft².

ACDF has a very low non union rate. According to the literature, fusion is achieved in 83-97% of cases when autograft is used and 82-94% when allograft is used³⁻⁹. As the number of levels increases the fusion rates decrease. This is because of the increase in the contact stress at the graft-body interface, which tends to lead to micromotion¹⁰. Non union rate for 2-level ACDF with allograft is 63% and 17% 23.5% with autograft^{11,12}. In 3 level ACDF non-union rates increase even more and may reach 37% 70%^{6,12-15}.

The introduction of plate fixation has increased fusion rates in three-level anterior cervical discectomy¹⁵⁻²⁰. The effectiveness of the 2 types of graft used in 2 and 3-level ACDF is open for debate. Although studies have demonstrated increased fusion rates with plate fixation for three-level ACDF, comparison of allograft vs. autograft has rarely been addressed.^{2,15,18,21-23} These studies reflect better results for autograft implantation.

The use of autograft is considered the gold standard for ACDF²⁶, however multiple disadvantages have been reported in connection with the classical graft harvesting site and technique. The harvest site for autogenous iliac crest bone grafts is associated with higher morbidity and longer operative time, hospital stay and postoperative recovery. Furthermore, patient dissatisfaction with the cosmetics of the iliac crest incision also contributes to the shortcomings of such a harvesting^{2,24-29}. The introduction of titanium cages has reduced donor site morbidity while achieving outcomes comparable to those of iliac crest autograft^{11,14,30-32}. The efficacy of allograft with cage compared to iliac crest autograft in plated three-level ACDF has not been studied.

The purpose of this retrospective study is to compare two commonly used techniques for 3-level ACDF in terms of fusion rate and their ability to reduce pain and decrease disability. These techniques are: 1) 3-level ACDF with a PEEK (polyetheretherketone) cage filled with allograft and an anterior plate and 2) 3-level ACDF with an iliac crest autograft and an anterior plate.

Patients and methodology

Our study is a retrospective analysis of 36 cases of 3-level ACDF with anterior semi rigid plating. All cases were performed by the same surgeon between August 2000 and June 2005. The study comprised 19 males and 17 females with an average age of 52.6 (range from 35 to 69). Operated levels were C4-C7 in 30 patients, C3-C6 in 5 and C5-T1 in one patient. 19 patients (52%) were implanted autologous tricortical iliac crest grafts, and 17 (47%) were implanted filled with allograft.

The technique used was the same in all cases: an anteromedial approach to the cervical spine. The intervertebral discs were removed. All patients had burring of the end plates, grafts were distracted and countersunk at 2mm from the anterior vertebral border. The autologous bone graft was tricortical and was harvested from the iliac crest using a low speed oscillating saw. Vacuum sealed fresh frozen cancellous chips and putty were used in those cases where allograft was used. An anterior cervical titanium

plate was selected with variable angle locked screws. 2 screws were placed at the end of the vertebral bodies of the plate as well as one segmental screw on each level spanned by the plate. Philadelphia collars were worn by all patients postoperatively for 6 weeks.

Clinical and radiographic data were obtained at 1 and 2 years postoperatively. Radiographic data consisted of lateral views in neutral position and in flexion and extension; these were evaluated by two independent reviewers for fusion. Radiographic fusion was defined by: absence of motion between the spinous processes on flexion-extension radiographs; absence of lucent lines between the graft and the endplate; presence of bridging bony trabeculae at the graft-endplate junction³².

Clinical outcome was assessed at 1 and 2 years' follow-up and rated according to the Odom criteria³² (table 1).

Results

Fusion was achieved in 18 (94%) patients in the iliac crest group (fig. 1) and 12 (71%) of the PEEK cage-allograft group (fig. 2). 1 patient in the iliac crest group (fig. 3) and 5 in the cage-allograft group developed nonunions.

Table 1 Clinical results. Odom score

Excellent	No complaint attributable to cervical disease; patient is able to perform daily activities without impairment
Good	Intermittent discomfort attributable to cervical disease; no significant limitations exist to daily activities
Fair	Subjective improvement in symptoms; physical activity significantly impaired
Poor	Worsening or no improvement

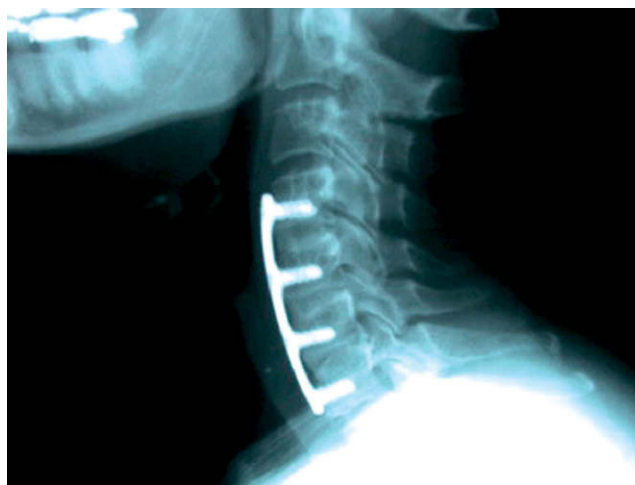


Figure 1 Fused 3 level ACDF at 2 years postop, with a tricortical iliac crest autograft.

Clinical outcome at 2 years was excellent in 5 patients, good in 12 and fair in 2 cases of the iliac crest group. In the cage-allograft group, the result was excellent in 3 patients, good in 13 and fair in 1 case (table 2).

The 5 nonunions (1 from the iliac crest group and 4 from the cage-allograft group) had good clinical outcomes; in one case the result was fair (table 3).

Discussion

Anterior cervical plate fixation is believed to stabilize the operative motion segments, decreasing graft migration and preventing graft collapse, which could lead to loss of cervical lordosis, malunion or nonunion and neurologic

compromise³³. Although reports have noted high fusion rates in plated multilevel ACDF ranging from 47%to 100%(15,34) depending on the number of levels fused^{15,34}, the efficacy of the combination of a titanium cage with allograft in comparison with autograft in such patients has not been investigated.

Although allograft use decreases donor-site morbidity, its slower vascular penetration, accelerated bone resorption, slow bone formation and weak osteoinductive features increase the risk of improper healing^{29,35,36}. Because one of the functions of the bone graft is to provide proper distraction of the intervertebral space or the intervertebral foramen, the biomechanical stability afforded by allograft in accommodating compressive forces is questionable. Freeze-dried allograft was found to undergo a 10% loss of

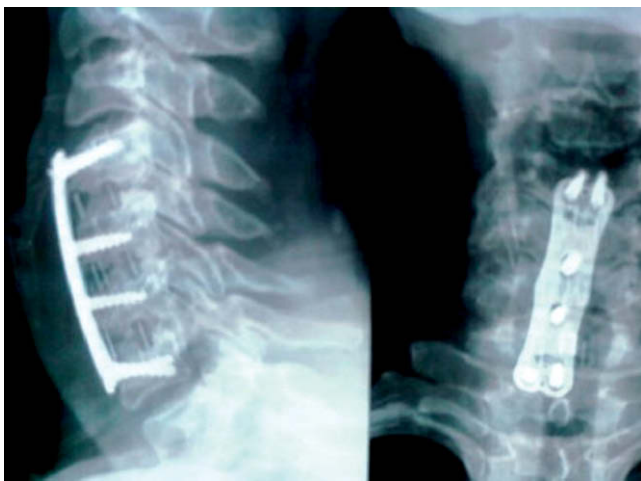


Figure 2 3-level ACDF at 2 years postop, with a PEEK cage with allograft.

Table 2 Functional assessment. Odom score

	Excellent	Good	Fair	Poor
Graft				
Autograft	5	12	2	0
Cage/ allograft	3	13	1	0
Total	8 (22.2%)	25 (69.4%)	3 (8.3%)	0

Table 3 Pseudoarthrosis (Odom score)

	Excellent	Good	Fair	Poor
Graft				
Autograft	0	1	0	0
Cage/ allograft	0	4	1	0
Total	0	5 (13.8%)	1 (2.7%)	0



Figure 3 Flexion-Extension X-rays showing nonunion at C6-7 in a patient in the tricortical iliac crest autograft group.

compressive strength and a 70% loss of torsional strength as compared with autogenous tricortical iliac crest bone³¹. For this reason a cage was used in the allograft group.

Eighty-three percent of our patients achieved fusion by 2 years postoperatively. There was a significantly higher nonunion rate when a cage plus allograft was used (29% vs. 6% in the autograft group). There was no statistically significant difference between the clinical outcome of iliac crest and cage-allograft patients. Now were there statistically significant differences in terms of the clinical outcome of fused and non fused patients after 1 and 2 years from surgery.

Clearly this study has several limitations mainly due to the small number of patients evaluated and the lack of a long term follow-up. A larger prospective randomized multicenter study should be undertaken to either confirm or refute our observations. We do also understand that we have not taken into account the biological factors or smoking habits of our patients, which may well affect bone healing and thus fusion rates.

Conclusion

From our study we concluded that although autograft is the gold standard for 3-level ACDF, the use of allograft can afford patients the same functional benefits, without prejudice to the higher rate of pseudarthrosis. The decision to use an autograft or a cage plus an allograft for ACDF is therefore based mainly on personal preferences.

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