A Radiological Evaluation of the Globus Coalition Cage Performance and Associated Complications in Anterior Cervical Discectomy and Fusion over 10 years.

Abstract

Objective: To evaluate radiological outcomes following use of the Global Coalition Cage (GCC) in ACDF along with associated clinical complications.

Methods: Retrospective data was collected from a database of spinal operations in Cardiff and Vale between 01/01/2014 and 01/05/2024. Clinical notes were used to record follow-up and radiological imaging used to assess fusion and complications.

Results: Data from 112 patients were collected then analysed. 4.5% had dysphagia postoperatively. 70% were discharged with a satisfactory X-Ray. 20.5% of surgeries were performed at C5/6 with the GCC. 88.5% of operated levels achieved fusion status with the GCC and 2.65% had non-union, of those assessed and confirmed using the Bridwell Classification System on CT. 8% required revision surgery with 77.8% indicated for Adjacent Segment Disease.

Conclusions: ACDF with the GCC has shown effective long-term outcomes with a risk of Adjacent Segment Disease comparable to alternative devices used for the same procedure.

Introduction

Anterior cervical discectomy and fusion (ACDF) has been established as the surgical intervention for cervical disc disease which manifests as radiculopathy, myelopathy and instability of the spinal joint(1). Patients with these conditions commonly present with symptoms such radiating arm pain, weakness, paraesthesia, neck pain and gait instability. Surgery becomes appropriate when conservative measures are no longer effective. These include analgesics and physiotherapy focused on stabilising and strengthening the cervical spine(2). When these fail to provide adequate relief, patients are then referred for corticosteroid injections which can help reduce inflammation and swelling at the site of compression to alleviate symptoms(3). These measures have shown to be inconsistent or show minimal improvement so ACDF is recommended to prevent worsening of neurological symptoms or deterioration in functional status (2).

Interbody graft and plate systems were initially used for the procedure, but standalone cages have demonstrated comparable effectiveness in ACDF. Advantages were shown by lowered incidence of postoperative dysphagia and Adjacent Segment Disease (ASD); where the levels above or below that which is operated on degenerates (4). Some studies have also shown greater risk of pseudoarthrosis and non-union in multi-level ACDF(5).

This report focuses on the Globus Coalition Cage (GCC), an integrated plate-and-spacer implant that combines fixation and support into one standalone device (6), which has been used in ACDF in Cardiff and Vale. Both radiological and clinical outcomes will be evaluated across 10 years.

Aims/Objectives

This service evaluation aims to look at the radiological outcomes of ACDF procedures performed using the GCC between 01/01/2014 and 01/05/2024 with a follow up of up to 2 years.

The primary objective of this study is to determine the rate of successful fusion associated with the GCC as demonstrated by radiological imaging. Secondary outcomes include the incidence of postoperative complications such as long-term dysphagia, non-union/pseudoarthrosis, loosening of the implant and ASD. Another objective is to evaluate how these complications are managed with either the use of conservative, medical, or surgical interventions.

Methods

Retrospective data was collected from the period 01/01/2014 to 01/05/2024 in Cardiff and Vale. A sample of 112 patients was collected who underwent ACDF using a GCC were identified and included in the study. Ethical approval was not required. Firstly, patients were identified through a database search of Bluespier. A document search using the keyword ‘coalition’ was performed to identify all spinal operations in which the GCC had been used for ACDF. This generated a list of eligible patients and provided indication for the surgery and number of levels operated on.

The Welsh Clinical Portal (WCP) was then used to review follow-up at approximately 6 weeks, 3 months, 6 months, 1 year and 2 years postoperatively. Patients were excluded if they were deceased or there was no documentation of follow up available. Synapse was also used to review AP and lateral cervical X-rays that were obtained immediately post-op and at discharge. Patients who had a CT scans or MRI of the cervical spine performed were also identified.

Data was collected into a spreadsheet for analysis. Specific postoperative complications were recorded including dysphagia, loosening of the metalwork, ASD and non-union/pseudoarthrosis. Complications were recorded if radiologically evaluated by CT or MRI with their findings. CT scans were then assessed using the Bridwell Classification System to identify fusion. Symptom recurrence of radiculopathy and myelopathy following surgery were documented along with any further treatments indicated including revision surgery and MRI scans which were reported to confirm ASD.

Statistical analysis required was conducted using Microsoft Office Excel.

Results

The table below demonstrates the demographics for the sample of 112 patients included in this study who had ACDF with the GCC from 01/01/2014 to 01/05/2024.

Number of Patients	Sex (%)	Average Age at the Time of Surgery (Yrs)	Surgical Indications (%)		1 Level ACDF (%)	2 Level ACDF (%)	3 Level ACDF (%)	Average time for immediate X-Ray postoperatively (Days)	X-Ray done at discharge (%)
112	Male = 67% Female = 33%	53.7 (SD=13.2; range = 17-81; 95% CI = 51.2-56.1)	**Radiculopathy**	53.6 (n=60)	54.5 (n=61)	40.2 (n=45)	5.4 (n=6)	1.83 (SD=2.03; range = 1-12; 95% CI = 1.5-2.2)	70 (n=78)
			Myelopathy	40.2 (n=45)					**Referred back later after being discharged (%)**
			Unstable Fracture of C-Spine from Traumatic injury	6.2 (n=7)					12.7 (n=10/78)

Table 1: Demographics of Patients who had ACDF with the GCC including number of patients, sex, average age, surgical indication, number of levels operated on, X-Rays done postoperatively and at discharge, and percentage of those referred back later after discharge.

Figure 1 below illustrates the frequency of specific spinal levels operated on during the procedures. The most common surgery for ACDF with the GCC was performed at C5/6 at 20.5% (n=23). Most ACDF surgeries done at two-levels were for C5/6 and C6/7 at 18.8% (n=21). The most ACDF surgeries done at three-levels was at C4/5, C5/6 and C6/7 at 2.7% (n=3).

From the data collected, 81 patients (72.3%) were either discharged or required no surgical input following ACDF with the GCC at the operated level. This was determined if the X-Ray imaging was satisfactory so were discharged, no more follow-ups specifically for the cervical spine recorded, a good prognosis was documented for the patient or further surgery was unlikely to provide any additional benefit. These findings were demonstrated in Figure 1 according to the levels at which the GCC was implanted during each surgery.

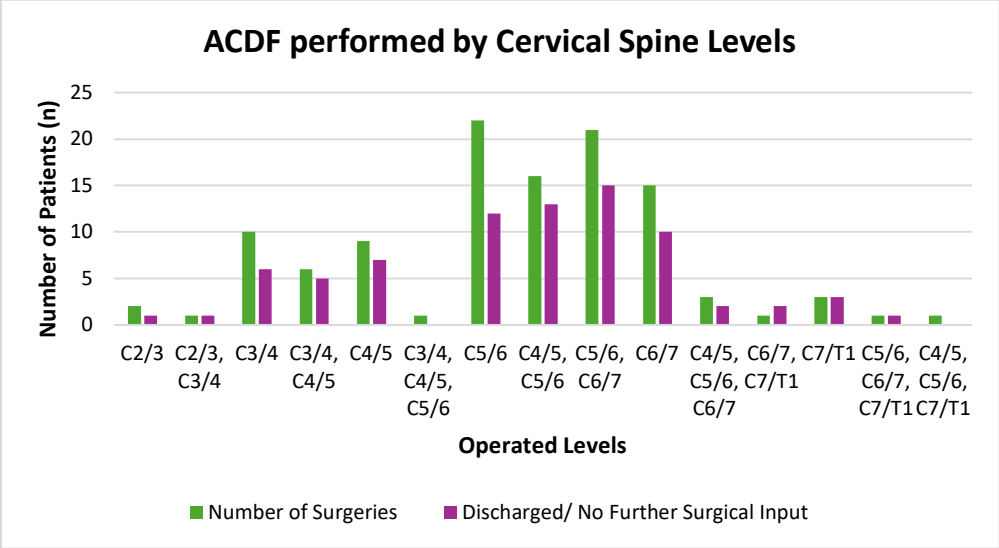

Figure 1 shows the number of ACDF procedures with the GCC by operated Cervical Spine Levels and patients discharged/required no further surgical input.

The maximum follow up duration can be seen in the table below. The maximum duration of follow up being 1 year at 23%, followed by 2 years at 19.5% then over 2 years being 18.6%.

Maximum follow up duration	Number of patients (n)	Percentage (%)
6 weeks	7	6.3
3 months	22	19.6
6 months	14	12.5
1 year	26	23.2
2 years	22	19.6
>2 years	21	18.8

Table 2 showing maximum duration of follow up for patients following ACDF with the GCC.

In this study, dysphagia was classed as a postoperative complication if patients required an ENT review or barium swallow study. Of the patients who had ACDF with the Globus coalition cage, 5 patients (4.5%) had dysphagia requiring review. Of these 5 patients, 3 were only reviewed by ENT, 1 only a barium swallow study and 1 had both.

During follow-up, some patients underwent further management with some patients receiving more than one intervention. 8.8% of patients were referred for further physiotherapy. 3.5% of patients had interventional injections including nerve root blocks or facet medial branch blocks of the cervical spine. 1.8% of patients were referred to the pain team to optimise analgesia.

25% (n=28) had radiculopathy and 8.9% (n=10) had myelopathy recurring following ACDF at the operated level. 19.6% (n=22) had ASD in the levels either above or below the operated ACDF level.

21 patients (18.8%) had a further CT scan of the cervical spine to confirm successful fusion with the GCC with an average duration of months for it to be completed being 28.8 (SD 33.8; range = 0.8-132; 95% CI = 22.6-35.1). 3 patients (2.7%) had non-union/pseudoarthrosis indicated on CT scan, with 1 being due to loosening of metalwork. The table below shows 15 CT scans analysed for success and maturity of spinal fusions using the Bridwell Classification System.

Bridwell Classification	Description	Fusion Status	Number of Levels assessed (n)	
Grade I	Solid fusion with complete remodelling and trabeculation across the fusion site	Fused	11	
Grade II	Graft appears intact with some remodelling, but there is no complete trabeculation and no lucency observed around the graft	Fused	12	
Grade III	Graft remains intact but there may be lucency present at the upper or lower end of the graft suggesting incomplete fusion (pseudoarthrosis)	Non-fused	3	C3/4 (1- level)*
				C5/6 (2-Level)*
				C4/5 (3-Level)*
Grade IV	Fusion is absent, with evidence of graft collapse and resorption, indicating non-union	Non-fused	0	

Table 3 shows evidence of fusion assessed on postoperative CT scans using the Bridwell Classification System. *Shows the indicated levels and number of levels operated on during the surgery.

39 patients (34.8%) had a further MRI scan of the cervical spine during follow up and the table below shows whether reports confirmed the presence of ASD by either significant spinal canal compromise or significant exit foraminal narrowing.

MRI of the Cervical Spine (n)					
No significant compression at operated or adjacent levels	**Adjacent segment disease**	**Wound Infection**	**Postoperative prevertebral soft tissue swelling**	**Total**	**Average duration for MRI scans (Months)**
18	18	1	1	38	23.3 (SD 23.7; range = 0.03-104; 95% CI = 18.9-27.7)

Table 4 showing reported findings for MRI scan of the cervical spine.

9 patients (8.0%) had revision ACDF surgery in the time the data was collected. Of this, 77.8% (n=7) had revision surgery for ASD, 11.2% (n=1) for non-union/pseudoarthrosis and 11.2% (n=1) for progressive degenerative change at the operated level.

Discussion

Previous studies have had mixed findings when comparing standalone cages to cage and plate constructs in ACDF. For example, one study (7) demonstrated higher fusion rates and a lower complication rates in cage and plate constructs in comparison to standalone cages. Despite the

advantages observed radiologically, there was no significant difference in clinical outcomes. The rates of non-union have shown to be greater in multilevel ACDF (5,8), particularly with standalone cages. Nevertheless, postoperative clinical outcomes such as dysphagia have been shown to decrease significantly(9), a major factor for quality of life in patients. Previous research done on another standalone cage similar to the GCC also showed favourable clinical improvement during patient follow up(10) but the small sample size and limited follow-up warranted further research. An elevated risk following ACDF would be ASD, which has shown to occur significantly less in patients with a standalone cages compared to cage and plate constructs (9,11).

Most patients in this study who underwent ACDF with the GCC experienced positive outcomes, with 70% being discharged after a satisfactory postoperative X-Ray and 12.7% of those being referred back later. A small proportion had complications with only 5 patients requiring further assessment due to long term postoperative dysphagia, in keeping with a lower rate in existing literature (9). Radiculopathy and myelopathy recurrence at 25% and 8.9% respectively was comparable to research also showing high symptom re-emergence postoperatively (12). 8.8% of patients required further physiotherapy for recovery and 3.5% found little relief and required injections such as nerve root blocks or facet joint injection.

Fusion status was evaluated using the Bridwell Classification System (14) and 23 levels (88.5%) could be assessed on CT to have achieved fusion. 3 patients had Grade 3 non-union on CT scan with 1 patient having revision surgery: a C4-T2 posterior fusion with C5-7 decompression. The remaining 2 patients were discussed in MDT and determined unfit for surgery. 1 of these patients had loosening of the screws of the Globus Coalition Cage causing non-union.

19.6% of patients were found to have evidence of ASD. 81.8% of those had an MRI scan of the cervical spine, the most sensitive imaging modality used to evaluate degeneration above or below operated levels (13). 52.6% of these involved ACDF done at C5/6 with the Globus Coalition Cage. 8% of patients required revision surgery with 77.8% of those being associated with ASD. This finding could reflect what other studies have seen where standalone cages were significantly better in treating symptomatic Adjacent Segment Disease (15).

There were several limitations. As the data was retrospective, a few patients had limited documentation recorded, missing information or were lost in follow-up which caused some variability. Delays in radiological imaging meant patients were reviewed before they were completed, causing delays to clinical decision-making or discharge planning. There may have been selection bias in the assessment of surgical success as some patients continued experiencing symptoms following ACDF but were discharged with satisfactory radiological outcomes or required no further surgical input. This introduced some subjectivity in assessment.

Conclusion

This service evaluation has demonstrated long term effectiveness using the GCC for ACDF. Radiological outcomes were shown to be favourable for the GCC on the operated level, supported high rates of fusion on CT imaging. However, ASD is a recognised complication reflected in MRI imaging of the cervical spine following ACDF which continues to emphasise the need for further treatment(16). Clinically, the GCC showed a favourable safety profile with low incidence of postoperative complications. Overall, the results support continued use of the GCC while highlighting the importance of radiological imaging in long-term follow-up.

References

1. Maharaj MM, Mobbs RJ, Hogan J, Zhao DF, Rao PJ, Phan K. Anterior cervical disc arthroplasty (ACDA) versus anterior cervical discectomy and fusion (ACDF): a systematic review and meta-analysis. (2414-469X (Print))
2. Margetis K, Donnally IC. Cervical Myelopathy. BTI - StatPearls.
3. Dydyk AM, Hu Y, Stretanski Mf Fau - Sekhri NK, Sekhri NK. Cervical Epidural Injection. BTI - StatPearls.
4. Elias E, Daoud A, Smith J, Elias C, Nasser Z. Assessing Surgical Outcomes for Cage Plate System versus Stand-Alone Cage in Anterior Cervical Discectomy and Fusion: A Systematic Review and Meta-Analysis. World neurosurgery. 2024;185:150-64. doi: 10.1016/j.wneu.2024.02.079
5. Bible JE, Kang JD. Anterior cervical discectomy and fusion: Surgical indications and outcomes. Seminars in Spine Surgery. 2016;28(2):80-3. doi: https://doi.org/10.1053/j.semss.2015.11.002
6. COALITION® Stand-Alone ACDF Spacer | Globus Medical. Globus Medical. 2025. Available from: https://www.globusmedical.com/products/coalition-spacer/.
7. Song KJ, Taghavi Ce Fau - Lee K-B, Lee Kb Fau - Song J-H, Song Jh Fau - Eun J-P, Eun JP. The efficacy of plate construct augmentation versus cage alone in anterior cervical fusion. (1528-1159 (Electronic))
8. Wright IP, Eisenstein SM. Anterior cervical discectomy and fusion without instrumentation. (1528-1159 (Electronic))

9. McDonnell JM, Youssef S, Ross TD, Marland H, Turley L, Cunniffe G, et al. The efficacy of anchored stand-alone spacers in comparison to conventional cage and plate in anterior cervical discectomy and fusion surgery: A meta-analysis of randomised controlled trials for clinical and radiological outcomes. (2772-5294 (Electronic))

10. Barbagallo GM, Romano D Fau - Certo F, Certo F Fau - Milone P, Milone P Fau - Albanese V, Albanese V. Zero-P: a new zero-profile cage-plate device for single and multilevel ACDF. A single institution series with four years maximum follow-up and review of the literature on zero-profile devices. (1432-0932 (Electronic))

11. Sahjpaul RL. Esophageal perforation from anterior cervical screw migration. (0090-3019 (Print))

12. Alzahrani BA, Alsharm FS, Salamatullah HK, Sulimany HH, Kashab MA, Khan MA. The Recurrence of Symptoms After Anterior Cervical Discectomy and Fusion. (2168-8184 (Print))

13. Ahn SS, So WS, Ku MG, Kim SH, Kim DW, Lee BH. Radiologic Findings and Risk Factors of Adjacent Segment Degeneration after Anterior Cervical Discectomy and Fusion : A Retrospective Matched Cohort Study with 3-Year Follow-Up Using MRI. (2005-3711 (Print))

14. Bridwell KH, Lenke Lg Fau - McEnery KW, McEnery Kw Fau - Baldus C, Baldus C Fau - Blanke K, Blanke K. Anterior fresh frozen structural allografts in the thoracic and lumbar spine. Do they work if combined with posterior fusion and instrumentation in adult patients with kyphosis or anterior column defects? (0362-2436 (Print))

15. Niu J, Song D, Liu Y, Wang H, Huang C, Yu H, et al. Revision Surgery for Symptomatic Adjacent Segment Disc Degeneration after Initial Anterior Cervical Fusion: Is ROI-C Better than Plate-Cage Construct? (2314-6141 (Electronic))

16. Huang X, Cai Y, Chen K, Ren Q, Huang B, Wan G, et al. Risk factors and treatment strategies for adjacent segment disease following spinal fusion (Review). LID - 33 [pii] LID - 10.3892/mmr.2024.13398 [doi]. (1791-3004 (Electronic))