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Do the Choice of Fusion Construct With and Without Autograft Influence the Fusion and Complication Rates in Patients Undergoing 1 or 2-Level Anterior Cervical Discectomy and Fusion Surgery? A PRISMA-Compliant Network Meta-Analysis

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Abstract

Study Design: Network meta-analysis.

Objectives: To compare the fusion outcome and complications of different 1 or 2-level anterior cervical decompression and fusion (ACDF) constructs performed with and without the application of autografts.

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Methods: We performed an independent and duplicate search in electronic databases including PubMed, Embase, Web of Science, Cochrane, and Scopus for relevant articles published between 2000 and 2020. We included comparative studies reporting fusion rate and complications with and without the use of autografts in ACDF across 5 different fusion constructs. A network meta-analysis was performed in Stata, categorized based on the type of fusion constructs utilized. Fusion constructs were ranked based on p-score approach and surface under cumulative ranking curve (SUCRA) scores. The confidence of results from the analysis was appraised with Cochrane's CINeMA approach.

Results: A total of 2216 patients from 22-studies including 6 Randomized Controlled Trials (RCTs) and 16 non-RCTs were included in network analysis. The mean age of included patients was 49.3 (±3.62) years. Based on our meta-analysis, we could conclude that use of autograft in 1- or 2-level ACDF did not affect the fusion and mechanical implant-related complications. The final fusion and mechanical complication rates were also not significantly different across the different fusion constructs. The use of plated constructs was associated with a significant increase in post-ACDF dysphagia rates [OR 3.42; 95%CI (.01,2.45)], as compared to stand-alone constructs analysed.

Conclusion: The choice of fusion constructs and use of autografts does not significantly affect the fusion and overall complication rates following 1 or 2-level ACDF surgery.

Keywords
anterior cervical discectomy and fusion, autologous bone graft, autograft, spinal fusion, complication rates, osteobiologics

Introduction

Anterior cervical discectomy and fusion (ACDF) is considered an effective and relatively safe surgical treatment for diverse cervical disorders like degenerative disc disease (DDD), disc herniations (DH), traumatic facet dislocations or discal injuries, neoplastic and infectious diseases.[1] It is one of the most commonly performed spinal surgeries in the United States, where approximately 137,000 ACDFs are performed every year.[2] The main goals of this surgery include decompression of the spinal cord and reconstruction of the spine to regain optimal alignment.[1,3] The overall complication rate for ACDF ranges between 13.2% and 19.3%.[4–8] Various studies have also raised concerns regarding progressive degeneration of the adjacent non-fused, cervical segments following ACDF, which may be attributed to multitudinous factors, namely abnormal biomechanical forces, a compensatory increase in range of motion and stress overload at the contiguous non-fused segments, loss of cervical lordotic alignment, secondary spinal imbalance and partly secondary to the natural progression of underlying DDD.[9–13]

Since the inception of ACDF in the 1960s, autograft has remained the gold standard for achieving inter-vertebral fusion. Traditionally, the autologous graft has been harvested from the iliac crest during ACDF surgeries. However, donor site complications like infection, nerve and blood vessel injury, and persistent pain or paresthesia have been common causes of patient dissatisfaction and morbidity.[14,15] To circumvent these donor site-related morbidities, allograft or other synthetic materials like polymethylmethacrylate (PMMA), hydroxyapatite (HA), bio-compatible osteoconductive polymers, heterologous artificial graft, and recombinant bone morphogenic proteins (rh-BMP) have been increasingly employed over the recent years. Although allografts and synthetic materials are advantageous in preventing the above-said donor site morbidities along with a reduction in the operative time, these synthetic graft substitutes are fraught with diverse disadvantages including enhanced surgical costs,[16] compromised fusion rates,[17] and radiological failure.[8] To date, there exists significant ambiguity regarding the benefits and pitfalls of the use of autograft, other bone graft substitutes, and different constructs for reconstruction in patients undergoing ACDF.[5,18,19] The current systematic review with network meta-analysis was thus planned to comprehensively analyze and compare the outcome and complication rates following the use of autologous graft material in patients undergoing ACDF across various fusion constructs utilized.

Materials and Methods

Data Search Strategy

A thorough literature search was performed following the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) guidelines[20] by four reviewers using PubMed, Google Scholar, EMBASE, Medline, The Cochrane library, and Scopus electronic databases. The search strategy included the MeSH terms for ACDF surgery with autografts and its reported complications using the use of boolean operators as illustrated in Supplementary Material (SM) 1.1 as per the PRESS guidelines.[21] All articles, published between January 1, 2010, and September 30, 2020, were included in our study, irrespective of the original language of publication.

Inclusion and Exclusion Criteria

The articles were included, based upon the following criteria following the PICOS framework as in Supplementary

Material (SM) 1.2. We only included studies utilizing autografts and excluded studies using allografts in their fusion constructs. Two reviewers were involved in the article selection process and any disagreement was resolved through discussions. We deduplicated the articles imported from all databases using citation manager software (Zotero). We also searched the bibliographies of the included articles for any potential studies not identified in the primary search.

Data Extraction and Outcome Measures

The data were extracted using a structured template based on the Cochrane Consumers and Communication Group recommendations. Two reviewers were involved in the data extraction process. Any disagreement between the authors was resolved through discussions. We expected heterogeneity in the definition of the outcomes of interest. Hence, we developed a working definition as a priori to be used throughout the data extraction process as given in Supplementary Material (SM) 2.1. We extracted details such as the year of publication, authors, country, and the number of patients enrolled in each arm of the study. The baseline details of the population such as their mean age, gender proportions, type of graft used, construct utilized, levels of fusion, follow-up period along with their outcome measures such as fusion at 1 year, all reported complications as in Supplementary Material (SM) 2.1 including infection, revision surgery, dysphagia, construct failure, graft collapse, subsidence, and clinically significant adjacent segment disease (csASD).

Risk of Bias

The studies were analyzed for the risk of bias. Those studies lacking appropriate data and those with a high risk of bias were recommended for exclusion. The risk of bias in each study was evaluated using either the Cochrane Risk of Bias RoB2 tool for randomized controlled trials (RCTs) and quasi-randomized trials; or the Cochrane ROBINS I tool for non-RCTs.[22,23]

Statistical Analysis

A network meta-analysis was performed to analyze the relative effects of various fusion constructs used in ACDF surgery with and without autografts compared to a control. Multivariate meta-analytic methods have been reported to mitigate the outcome reporting bias noted in pairwise meta-analyses.[24] The analysis was performed in Stata (16.1, Stata Corp LLC). Since we were working on complications, we expected results with multiple null values across the included studies. We found the conventional .5 adjustments for the null value in network meta-analysis as suggested by White[25] would affect the final results of the rare event outcomes when computed on cumulative assumptions. We, therefore, adjusted them with a value of .1 for the assimilation of computational matrices across the studies in the network.

A network map was plotted for the individual outcome adjusted for the number of studies and the total number of subjects involved in the individual arms. We evaluated the global inconsistency in the network by analyzing the difference between the direct treatment-effect estimates from head-to-head comparisons and treatment-effect estimates obtained from indirect information for the outcomes analyzed. If a treatment belonged to a closed loop of evidence in the network (both direct and indirect effects available), their difference was calculated along with their 95% confidence intervals. The differences were further quantified with *P*-values which denoted the likelihood of conflict to be attributable to chance, and a *P*-value <.05 was considered suggestive of inconsistency. In such cases, the inconsistency model of network meta-analysis was utilized and the inconsistency was further explored with sensitivity analysis using the network side-split method.[25] If no inconsistency was detected and $P > .05$, a consistency model of network meta-analysis was used. We reported the results in a forest plot using the pooled log odds ratio (OR) and 95% confidence intervals (CI) for the individual arms in the network to demonstrate their effect on the outcome analyzed compared to a control arm. We also presented the individual pairwise comparison within the network. To account for the heterogeneity across the arms in the network, we chose the random effects model of analysis using the common variance approach.[26]

We ranked the treatments based on the p-score approach, where the cumulative probability of an intervention being the best possible treatment is evaluated; and the p-score ranges from 0 for the worst treatment to 1 for the best treatment.[27] We presented the ranking of the interventions with the rankogram and surface under cumulative ranking curve (SUCRA) values.[28] Publication bias was analyzed with a Funnel plot for the outcomes in the included studies.

Confidence Analysis of Evidence

The confidence of evidence generated across the included studies was evaluated using the Confidence in Network Meta-Analysis (CINeMA) approach[29] and performed in the CINeMA app.[30] CINeMA uses six domains to explore the confidence in the network results such as within-study bias, reporting bias, indirectness, imprecision, heterogeneity, and incoherence. All the domains were rated as 'no concerns', 'some concerns', or 'major concerns' apart from reporting bias which was reported as 'suspected' or 'undetected'. The final overall judgment on the confidence of evidence for each treatment comparison was rated 'very low', 'low', 'moderate', or 'high'.

Results

Upon detailed literature search from the electronic databases, 1090 articles were shortlisted for initial screening, which after de-duplication resulted in 584 articles. We further performed title and abstract screening and excluded 431 articles. We selected 153 articles for full-text review and found 22 eligible studies for inclusion in the analysis (2216 patients were included in them). We presented the PRISMA flow diagram for the inclusion of studies in the analysis in Figure 1. Of the 22 studies, six studies were RCTs,[13,31–35] eight studies were prospective non-randomized trials,[36–43] and eight studies were retrospective comparative studies.[44–51] All the included studies reported at least one of the outcomes of interest comparing the use of autograft with a comparator in 1-2 level ACDF surgery. The baseline characteristics of the studies included in the network are presented in Supplementary Material (SM) 1.3. The network plot adjusted for the number of included studies and total patients in individual treatment arms for all the outcomes analyzed is presented in Supplementary Material (SM) 3.1. The network had 5 fusion constructs used in ACDF surgery with regards to the autograft usage, namely standalone cage (SAC), standalone cage with graft (SACG), graft plate (GP), cage with graft and plate (CGP), and standalone graft (SAG). The network had 10 possible pair-wise comparisons, among which 9 had direct evidence data. The network had 19 two-armed studies and 3 multi-armed studies.

The included studies had a global contribution of patients into the network with Europe being the major contributor with 55% (n = 12) studies included. We did not note significant variability among the characteristics of the included patients in the network concerning age and gender proportions. The mean age of the included patients was 49.3 (±3.62) years. Of the 22 included studies, 10 studies[13,31,33,34,40,43,45,46,49,51] analysed the role of autografts in single level ACDF surgeries while remaining 12 studies[32,35–39,41,42,44,47,48,50] analysed the role of autografts in both single and two-level ACDF surgeries.

Quality Assessment

We assessed the methodological robustness of included studies in the network with RoB2 and ROBINS I tools of Cochrane Collaboration. None of the included studies had an overall high risk of bias to be excluded from the analysis. The risk of bias of the pairwise comparisons is presented in Supplementary Material (SM) 4.1 We did not find any significant publication bias using the funnel plot as shown in Supplementary Material (SM) 4.2.

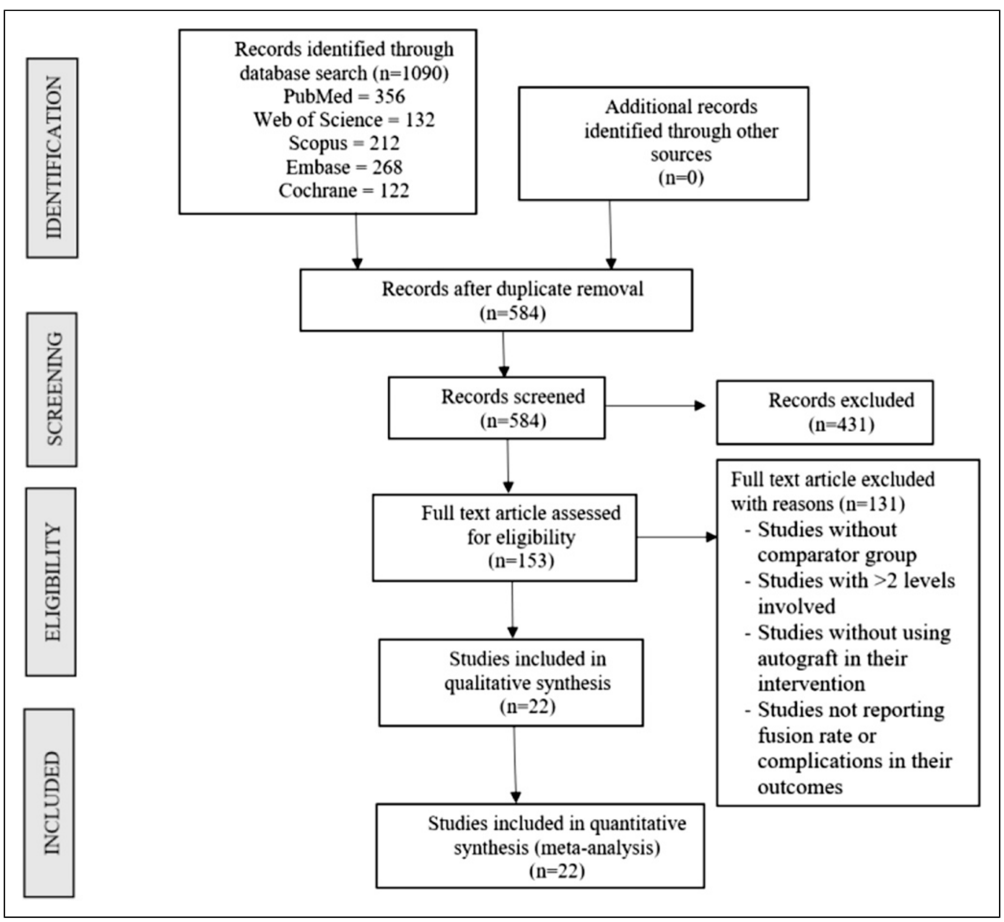

Figure 1. PRISMA flow diagram of selection of studies included in the analysis.

Network Analysis Results

We performed a pooled network meta-analysis using a frequentist approach on every outcome of interest. We formulated the SUCRA ranking of various fusion constructs with or without autografts analyzed in the network based on their associated probabilities using the p-score approach for every outcome of interest. Of all the treatment arms in the network, SAG had high data strength with all other comparators as shown in the network plots in Supplementary Material (SM) 3.1 and hence all the outcomes were expressed in comparison to the performance of the SAG fusion construct.

Fusion Outcome at 1 Year. Fusion at one year was reported in 19 of the included studies,[13,31,33–36,38–43,45–51] involving 1639 patients. Figure 2A shows the pooled forest plot of the fusion outcome at 1 year compared to SAG. Although faster union rates were seen with plated fusion constructs compared to SAG, we did not find any significant difference in the rate of fusion at 1-year across all the fusion constructs in the network. The individual pairwise comparison forest plot of the treatment arms are presented in Supplementary Material (SM) 5.1. Upon ranking the fusion constructs based on the fusion outcome at 1 year, we noted GP to be the ideal construct to achieve faster union with 80% SUCRA score followed by CGP with 70% SUCRA score as shown in Supplementary Material (SM) 5.2 The rankogram of the fusion constructs for fusion outcome is presented in Supplementary Material (SM) 5.3.

Complication Outcomes. We analyzed the reported complications across all the included studies with 2216 patients pooled in the network and their results are presented as follows:

Infection. The pooled forest plot for post-operative infection across various fusion constructs is given in Figure 2B. The choice

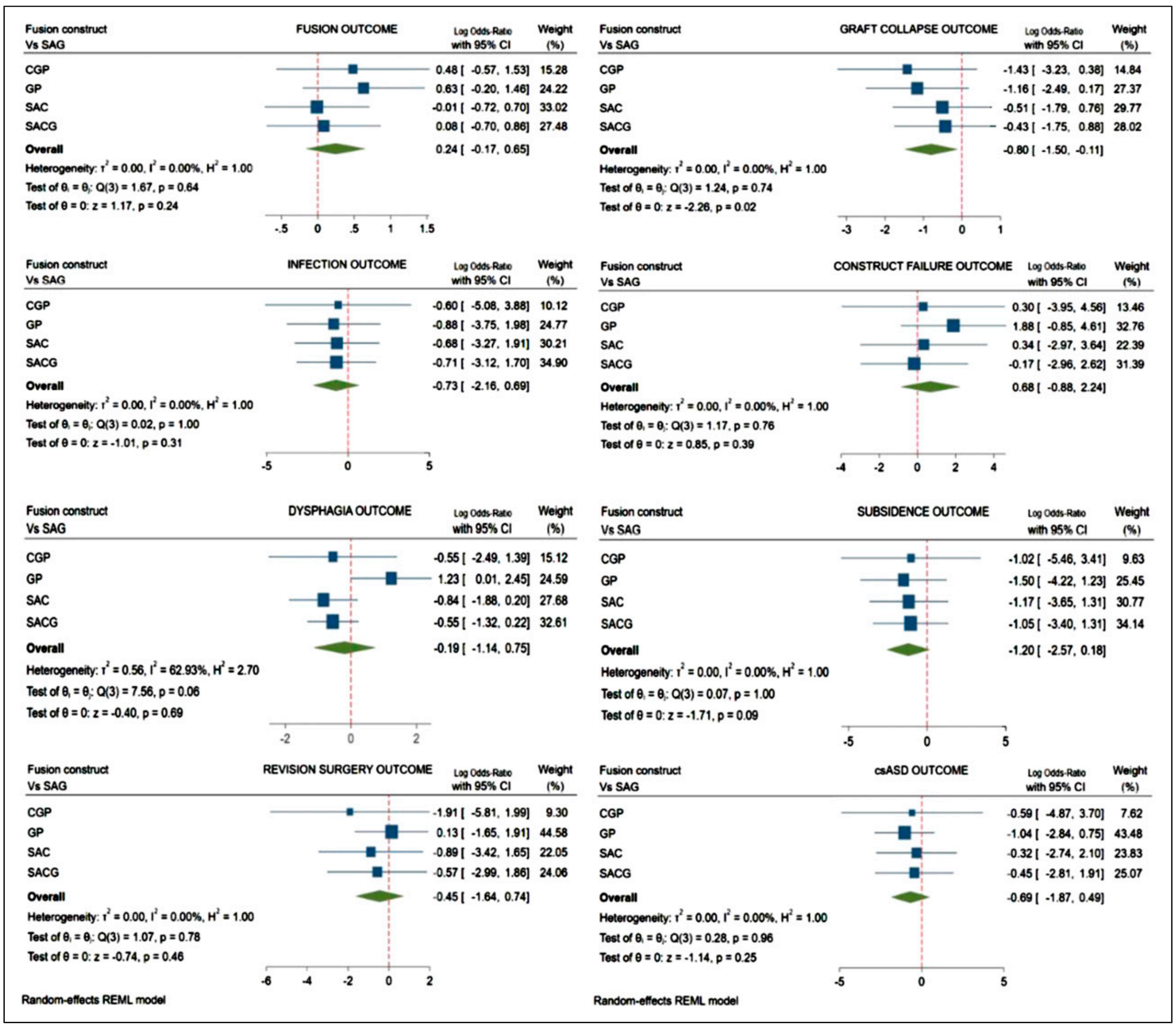

Figure 2. Forest plot comparing the fusion constructs utilized across the included studies for the outcomes analysed.

of the fusion constructs or graft usage was not shown to predispose to postoperative infection. We did not find any significant difference in the reported infection following ACDF surgery across other fusion constructs compared to SAG. The individual pairwise comparison forest plot of the treatment arms are presented in Supplementary Material (SM) 6.1. Upon ranking the fusion constructs based on the reported infections, we noted GP and SAC to be the ideal constructs with the least reported infection post-surgery in the included studies with 60% SUCRA scores each. The SUCRA scores and the rankogram of the fusion constructs for infection outcome are presented in Supplementary Material (SM) 6.2 and Supplementary Material (SM) 6.3 respectively.

Dysphagia. The pooled forest plot for post-operative dysphagia across various fusion constructs is given in Figure 2C. We noted the GP fusion construct to demonstrate a significant risk of dysphagia following ACDF surgery with [OR 3.42; 95% CI (.01,2.45), $P < .05$], as compared to SAG. The individual pairwise comparison forest plot of the treatment arms are presented in Supplementary Material (SM) 7.1. Upon ranking the fusion constructs based on the reported dysphagia events, we noted SAC and SACG to be the ideal constructs with the least reported dysphagia events post-surgery in the included studies with 80% SUCRA scores each. The SUCRA scores and the rankogram of the fusion constructs for dysphagia outcome are presented in Supplementary Material (SM) 7.2 and Supplementary Material (SM) 7.3 respectively.

Revision Surgery. The pooled forest plot for revision surgery across various fusion constructs is given in Figure 2D. Although the GP fusion construct seems to have a higher risk of revision surgery, we did not find any significant difference across all fusion constructs when compared to SAG. The individual pairwise comparison forest plot of the treatment arms are presented in Supplementary Material (SM) 8.1. Upon ranking the fusion constructs based on the revision surgery events, we noted CGP to be the ideal construct with the least reported revision surgeries followed by SAC with 80% and 60% SUCRA scores respectively. The SUCRA scores and the rankogram of the fusion constructs for revision surgery outcome are presented in Supplementary Material (SM) 8.2 and Supplementary Material (SM) 8.3 respectively.

Graft Collapse. The pooled forest plot for reported graft collapse across various fusion constructs is given in Figure 2E. The individual pairwise comparison forest plot of the treatment arms are presented in Supplementary Material (SM) 9.1. Although plated constructs such as CGP and GP seem to have lesser events of graft collapse, we did not note any significant difference across all fusion constructs when compared to SAG. Similarly, CGP and GP were noted to be the ideal constructs with the least reported graft collapse with 80% SUCRA scores each. The SUCRA scores and the rankogram of the fusion constructs for graft collapse are presented in Supplementary Material (SM) 9.2 and Supplementary Material (SM) 9.3 respectively.

Construct Failure. The pooled forest plot for construct failures across various fusion constructs is given in Figure 2F. Although GP seems to have higher reported construct failure events, we did not note any significant difference across all fusion constructs when compared to SAG. The individual pairwise comparison forest plot of the treatment arms are presented in Supplementary Material (SM) 10.1. Upon ranking the fusion constructs based on the reported construct failure events, we noted SACG and SAC to be the ideal fusion constructs with the least reported fusion construct failures with 70% and 60% SUCRA scores respectively. The SUCRA scores and the rankogram of the treatment arms for construct failures are presented in Supplementary Material (SM) 10.2 and Supplementary Material (SM) 10.3 respectively.

Subsidence. The pooled forest plot for reported subsidence across various fusion constructs is given in Figure 2G. Although SAC and SACG seem to have higher reported subsidence events, we did not note any significant difference across all fusion constructs when compared to SAG. The individual pairwise comparison forest plot of the treatment arms are presented in Supplementary Material (SM) 11.1. Upon ranking the fusion constructs based on the reported construct failure events, we noted GP to be the ideal fusion constructs with the least reported subsidence events with a 70% SUCRA score. The SUCRA scores and the rankogram of the fusion constructs for subsidence outcome are presented in Supplementary Material (SM) 11.2 and Supplementary Material (SM) 11.3 respectively.

csASD. The pooled forest plot for csASD across various fusion constructs is given in Figure 2H. We did not note any significant difference across all fusion constructs when compared to SAG for reported csASD events. The individual pairwise comparison forest plot of the treatment arms are presented in Supplementary Material (SM) 12.1. Upon ranking the fusion constructs based on the reported csASD, we noted GP and SACG to be the ideal fusion constructs with the least reported csASD events with 70% and 50% SUCRA scores respectively. The SUCRA scores and the rankogram of the fusion constructs for csASD outcome are presented in Supplementary Material (SM) 12.2 and Supplementary Material (SM) 12.3 respectively.

Sensitivity and Subgroup Analysis. We did not find significant heterogeneity across various outcomes analyzed in the network as shown by the heterogeneity values in Figure 2. We sub-grouped and analyzed the studies with and without the usage of grafts, categorized based on the cage construct utilized in them. We did not find any significant difference across the treatment arms for fusion outcome as presented in

Supplementary Material (SM) 13.1. We also analyzed the impact of two-level studies included in the network and did a sub-group analysis based on the number of levels of fusion involved. We did not find any significant difference based on the levels of fusion involved in the surgery among the included studies in the network as shown in Supplementary Material (SM) 13.2. We could not perform a sub-group analysis of fusion in studies at time points less than one year due to the limited number of studies with sufficient data to proceed with the analysis.

Consistency. We did not find any significant evidence of global inconsistency that affected the transivity of the network results. We presented the results of consistency analysis with chi-square values in the corresponding pair-wise comparison forest plots of respective outcomes. In some of the paired networks analyzed, we noted the indirect pooled estimates to have wider CI compared to direct estimates, without any evidence of systematic differences concerning the potential effect modifiers. We considered these apparent inconsistencies to be an effect of the true differences between the direct and indirect estimates, and the indirect estimates reflect a more precise estimate as they are from a network with a larger number of studies.

Confidence in Evidence. The grading of paired comparisons in the network with the CINeMA approach showed "moderate" confidence across most of the paired comparisons for fusion outcome as shown in Supplementary Material (SM) 14. The major reason to downgrade the quality of evidence was the imprecision in the indirect estimates due to wider CIs extending on both sides of the axis. We also noted some concerns with the within-study bias owing to the poor reporting of some of the outcome measures of interest.

Discussion

Since the initial description by Smith and Robinson in 1958, ACDF has emerged as one of the most common and successful spinal procedures for a wide variety of disorders.[30–32] The surgery is divided into three distinct steps. The first step involves exposure of the affected discs, the second step is the decompression of neural elements; and the final step constitutes the reconstruction of disc space with an inter-body spacer material. Although the first two steps have undergone minimal changes in the past five to six decades, the third step has undergone an extensive transformation.[30–51] While the initial reconstruction methods relied heavily on an isolated structural autograft inserted into the disc space, the technique has evolved to involve a wide range of interbody spacer materials with additional reinforcement with anterior plating or in-built screw systems. The structural autograft has also been replaced by allograft, non-structural grafts, and alternate osteobiological agents. Although studies have shown that the correct choice of construct can make a substantial difference in the outcome following multilevel ACDF, there is currently no clear evidence regarding the impact of the type of reconstruction on the final outcome following single- or two-level ACDF.[30–51] The present meta-analysis was thus planned to compare the radiological fusion outcome and complication rates for patients undergoing 1- or 2-level ACDF with and without autograft across 5 different constructs for interbody reconstruction, namely graft-plate (GP), cage with graft-plate (CGP), stand-alone cage (SAC), stand-alone cage with graft (SACG) and stand-alone graft (SAG) constructs. To the best of our understanding, there is no similar study in the hitherto published literature providing large-scale, high-level evidence on this subject.

As previously discussed, based on our analysis, there is no substantial inconsistency or heterogeneity among the existing studies with regard to the concerned variables analyzed in our meta-analysis.[30–51] Given certain aforementioned biases and wide CI for some variables, we consider the currently available evidence on this subject in the literature to be of moderate quality.

One of the foremost determinants of long-term outcomes following ACDF is the achievement of definitive radiological and clinical fusion of the concerned cervical motion segment. In 1-2 level ACDF, the fusion rate at 1 year has been reported to range between 79.9% and 100%.[30–51] A majority of studies included in our analysis reported the radiological fusion rates at the end of one year. Different studies had employed different criteria to define radiological union. Different imaging modalities like X-ray (static and dynamic), CT, and MRI have been utilized across studies; although a majority of studies relied upon plain radiographs to define radiological union during follow-up evaluation. Radiological parameters like substantial intervertebral movement (in angular or translational planes), presence of demonstrable, progressive radiolucencies between the interbody spacer and adjoining endplate, presence or absence of trabecular continuity, implant stability or loosening, and Bridwell fusion grading have been used to evaluate radiological fusion.[30–51] However, we used the criteria for fusion defined by Oshina et al [52] as a priori for comparison of fusion criteria across studies and found most of the studies reporting fusion to be concordant with the defined criteria. Based on our current review, there was no statistically significant difference in terms of fusion at one-year post-operative time point among the 5 different constructs, irrespective of whether the patient had autograft or not. Therefore, it seems to be evident that in this group of patients undergoing 1-2 level ACDF (in whom the fusion rates are already good), the use of autograft or the type of reconstruction performed after discectomy does not significantly affect the final fusion after one year of surgery.

We, however, could observe that the rate of fusion was not entirely similar for all the types of constructs. The use of constructs augmented with an anterior plate has been recommended in multilevel ACDF. Reinforcement with an anterior plate provides additional stability to long-segment constructs; and seems to substantially mitigate pseudoarthrosis, subsidence, and failure rates.[30–42] In our study, although there was no significant difference in the achievement of final fusion among the five different constructs, the incorporation of a plate (GP and CGP) was associated with relatively shorter healing times following 1-2 level ACDF.

We also compared the implant-related complications among the 5 different constructs (with or without autograft). We did not observe a statistically significant difference concerning graft collapse, subsidence, or construct failure among the different reconstruction strategies. Among the different techniques, constructs with plate reinforcement (GP and CGP) had a relatively more favorable outcome concerning graft collapse (although the difference was not statistically significant). We did not analyze the impact of the fusion constructs on the radiological parameters such as maintenance of lordosis correction where plated constructs might have fared well with their least reported graft collapse rate. Although we did not find any significant difference across the fusion constructs, the SAG construct had the highest subsidence rate among the studied constructs. Such a construct has the least biomechanical stability and is understandably associated with a relatively greater incidence of graft collapse and disc space subsidence (even in 1-2 level ACDF).[40–44]

We evaluated the rates of revision among the 5 different reconstruction strategies. Similar to the other parameters studied, there was no statistically significant difference in the rates of revision surgeries among the diverse constructs. Among all the included techniques, CGP had the best outcome concerning the need for revision surgery. In general, revision surgeries after ACDF may be necessary for multiple reasons like pseudoarthrosis, infection, progressive deformity, ASD or a combination of these.[30–48] Studies have reported revision rates ranging between 2.1% and 9.13% following single-level ACDF; and between 4.4% and 10.7% after multi-level ACDF.[35–39] Although we did not find any significant difference among the studied constructs, CGP was found to be a construct for ACDF with relatively lower incidence of complications necessitating revision surgical interventions following single- or two-level ACDF.

One of the most crucial mid- to long-term complications following ACDF is the development of degeneration at the adjacent non-fused motion segments. csASD has been reported as the most common reason for revision procedures following ACDF, with an average incidence of 1.6-4.2%/year.[53] Studies have reported that the presence of a plate can be a potential risk factor for developing degeneration at the adjacent non-fused segments. This may be attributed to the various factors associated with plate insertion like the need for greater dissection (for accommodating the plate), higher chances for disc or anterior longitudinal ligament (ALL) violation, mechanical irritation of the implant over disc space, or interruption of the vascularity to the adjoining disc or end plate.[13,30–51] However, in our study, there was no statistically significant difference in the reported incidence of csASD among the different constructs. One of the important reasons for the development of ASD is the alteration in the segmental and global alignment of the cervical spine post-operatively, which may, in turn, modify the biomechanical stresses across the non-fused vertebral segments.[13,52] In single- and double-level ACDFs, the spinal lordotic alignment may not be substantially altered (as compared with longer segment fusions). This may explain the absence of significant differences in the csASD rates among the different constructs. Additionally, not all radiologically-evident ASDs manifest significant clinical symptoms.[36,39] Therefore, although the radiological ASD (although not reported in our study) may slightly vary among the different constructs in 1-2 level ACDFs; based on our analysis, the use of different fusion constructs does not affect the development of csASD.

Apart from the aforementioned variables, we also compared the complication rates among the different constructs. Although widely regarded as a safe surgery, ACDF has been reported to be associated with a wide range of complications like post-operative hematoma, wound complications, infections, dysphagia, neurological deterioration, recurrent laryngeal nerve palsy, esophageal or another vital structure injury, and cerebrospinal fluid (CSF) leak.[30–51]

In the current study, the evidence in the current literature regarding all these aforementioned complications was analyzed and compared across the fusion constructs of interest. We could observe a statistically significant association between the use of plate constructs (CGP and GP) and post-operative dysphagia. This was the only statistically significant difference observed in our study. Dysphagia is one of the most common post-ACDF complications, with a reported incidence as high as 80% following surgery.[54,55] Previous studies have also demonstrated the presence of dysphagia as an independent predictor for longer length of postoperative hospital stay and patient re-admission.[56] Additionally, factors like female sex, multilevel or revision surgeries, endotracheal pressures, and use of local steroids have been reported to affect dysphagia rates.[53,57] Overall, we did not observe a significant correlation between any of the other aforementioned complications and different fusion constructs in our analysis.

Although the current study is one of the most comprehensively-performed reviews of the existing literature on the subject, we also have certain limitations. The evidence presented is of moderate quality owing to certain aforementioned biases within the included studies and wide confidence intervals for certain variables. Since the purpose of the study was to compare the outcomes and complication rates of different ACDF constructs with and without autografts, studies that only included constructs with allografts were excluded. We also did not compare the clinical and functional outcome measures for different ACDF constructs, or pre-and post-operative radiological alignment variables.

Conclusion

Based on our comprehensive network meta-analysis, we could conclude with moderate quality evidence that the use of autograft in 1- or 2-level ACDF did not affect the achievement of final fusion and mechanical implant-related complications like subsidence, graft collapse, construct failure, csASD, and need for revision surgical intervention. The final fusion and mechanical complication rates were also not significantly different across the five different ACDF fusion constructs (namely, CGF, GF, SAC, SACG, and SAG). The use of plated fusion constructs (CGF and GF) was associated with a statistically significant increase in the post-ACDF dysphagia rates.

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Declaration of Conflicting Interests

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Supplemental Material

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