

## Peer Review File

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### Reviewer A

This is a single-center retrospective study of 121 ACDF patients comparing the use of Mayfield to headrest. The authors report a significantly higher radiation dosage in the headrest group. This is an interesting finding, which has implications for radiation exposure for both patients and surgeons; however, there are a number of methodological limitations, detailed below.

**Comment 1:** This sentence (line 58) should be restated as "...Mayfield skull clamp is associated with lower doses..." to avoid any implication of causality given the retrospective and exploratory nature of the study.

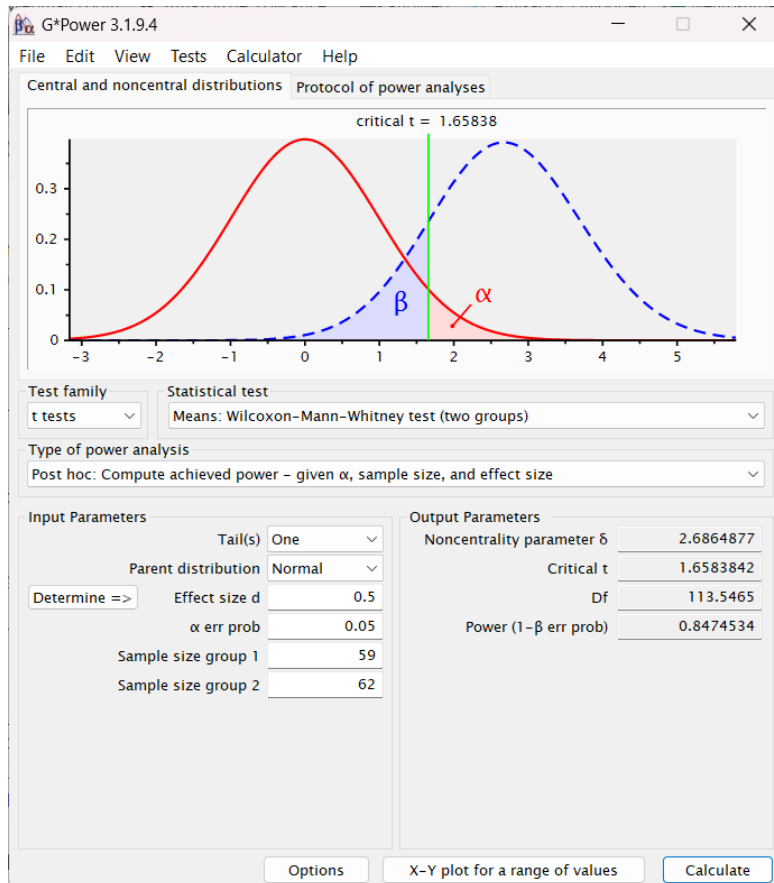
**Reply 1:** We have now revised the sentence as suggested.

**Changes in the text:** See Page 2, Highlight Box point number 3

**Comment 2:** It is not clear how power calculations (line 96) were performed. Usually this requires an assumption of the magnitude of difference for a pre-specified dependent variable of interest in order to determine the sample size necessary to demonstrate this difference with reasonable likelihood. The use of a power calculation seems to contradict the statement that this is an exploratory analysis (line 136), as this would require a pre-specified hypothesis.

**Reply 2:** We agree with the reviewer that power analysis for a retrospective, exploratory analysis is statistically and conceptually contradictory. In practice this study was conducted after use of the padded head rest in our department was introduced in 2021, so that cases were included for the two years between 2021 and 2023 (when the analysis was performed) and then retrospectively for the same time period of two years. As reporting of a sample size/power calculation was required for reporting in the STROBE guidelines, GPower was used to perform a post hoc analysis (see below). As we agree that this is not a statistically meaningful analysis, the information has been changed in the manuscript to describe the practical means by which we arrived at the number of patients included in the study: "Sample size was arrived at by including patients for two years before and after introduction of patient positioning using the padded head rest in our institution."

**Changes in the text:** (See page 3 lines 67-68).



**Comment 3:** Does “revision of previously performed ACDF” (line 99) include ACDF for adjacent segment disease?

**Response 3:** We thank the reviewer for pointing out this important information. Revision of previously performed ACDF was considered when material revision was necessary due to improper placement, loosening or dislocation and did not include adjacent segment disease. We have now added this information to clarify our exclusion criteria.

**Changes in the text:** (see page 3, line 76-77).

**Comment 4:** Was a standardized definition for myelopathy used (line 113)? Was this diagnosed on a purely radiographic basis?

**Reply 4:** Myelopathy was diagnosed based on MRI imaging alone and was only included if present in the segments addressed by surgical treatment. This information has now been clarified in the text.

**Changes in the text:** See pages 3-4, lines 89-90

**Comment 5:** I believe this should read “(p = 0.419)” (line 160).

**Reply 5:** We thank the reviewer for pointing out this typing error, which we have now corrected to read 0.419.

**Changes in the text:** (See page 5, line 131.

**Comment 6:** The most common diagnosis is listed in the text as both 1-level disc herniation without myelopathy (line 157) and 1-level stenosis with myelopathy (line 161). It should be specified that this refers to the Headrest and Mayfield groups, respectively.

**Response 6:** We thank the reviewer for pointing out this misleading formulation. We have now corrected to text to clarify that we are referring to the total population. The sentence “The most common diagnosis was 1-level disc herniation without myelopathy” was an error and has now been removed.

**Changes in the text:** See page 5, line 127.

**Comment 7:** The first group under the “Level” header (table 1) should be C1-4 to maintain consistency with the table legend and the manuscript text.

**Response 7:** We thank the reviewer for this suggestion and have now changed the group name to “C1-4”.

**Changes in the text:** See Table 1

**Comment 8:** In testing for differences in diagnosis (table 1), procedure performed (table 2), and mRS (table 3) the expected group counts are quite low due to the large number of categories used relative to the sample size, making a chi-squared test inappropriate. Fisher’s exact test should be used with such small groups. For diagnosis (table 1), it may be clearer to report myelopathy as a separate variable to reduce the number of diagnosis groups and make it easier to see if there are differences with respect to myelopathy rates.

**Response 8:** We have performed Fisher’s exact test on the variables “diagnosis” and “procedure” as suggested and adjusted the p-values accordingly ( $p=0.557$  and  $0.074$ , respectively). (See table 1 and table 2). As suggested, we also performed analysis on myelopathy as a separate variable, which was not found to be statistically significantly different between the Mayfield and Headrest groups ( $p=0.250$ ) and have added these results to table 1. As we still wish to address the different levels treated in surgery and whether Myelopathy is present, we have added the variable of Myelopathy (yes/no) across all cases.

**Changes in the text:** see Table 1 and Table 2.

**Comment 9:** The units for length of surgery (table 2) should be specified.

**Response 9:** We thank the reviewer for pointing out this missing information, which has now been added.

**Changes in the text:** See table 2.

**Comment 10:** It seems strange to separate the Chief of the department from other surgeons (table 2) unless there is a specific reason we would expect this individual’s outcomes to be particularly different. Grouping by number of years of experience or number of prior ACDFs performed prior to the study period would be more objective.

**Response 10:** We agree with the reviewer that the separation of the Chief surgeon may appear subjective, however in our institution the Chief clearly has performed the most ACDFs compared to attending and resident physicians, so that this separation certainly reflects the surgical experience. We have amended this information in the text.

**Changes in the text:** See page 4, line 92.

**Comment 11:** The number of levels and use of plate should be analyzed as separate variables (table 2). Combining these two variables inflates the number of procedure groups, giving the appearance of no significant difference in procedure distributions between the Mayfield and headrest groups; however, any difference would have to be drastic to demonstrate statistical significance with such small group sizes.

**Response 11:** We have now performed analysis (Fisher's exact test) of the use of an anterior plate as well as the levels (one, two or three levels) as separate variables, resulting in four groups (see below). Here we found no statistically significant differences between the Mayfield and the Headrest group. These findings are displayed below. As this analysis did not lead to new significant findings, we have kept the initial analysis including a more differentiated separation of procedures using six categories of interventions.

	<b>Mayfield</b> n (% of total)	<b>Headrest</b> n (% of total)	<b>p</b>
<b>Procedure</b>			
Any level w/anterior plate	13 (21%)	17 (19%)	0.533
1 Level	5 (8%)	9 (15%)	
2 Levels	5 (8%)	1 (3%)	0.074
3 Levels	5 (8%)	2 (5%)	

**Comment 12:** The lack of significant difference in procedure type is borderline ( $p = 0.069$ ) (table 2). The fact that a significance difference was not demonstrated does not imply that there is no difference. Both the number of levels and use of an anterior plate would be expected to affect radiation dose as using more pieces of hardware requires using more xrays to confirm their placement. The authors should perform a linear regression with dose area product as the dependent variable. In addition to Mayfield vs. headrest as an independent variable, other variables should be controlled for, particularly the number of levels of surgery and use of an anterior plate. If the authors can demonstrate that the differences in radiation dose are not simply due to differences in hardware it would greatly strengthen the study.

**Response 12:** The authors thank the reviewer for this suggestion. We have now performed multiple linear regression analysis in our cohort and observed that type of head fixation ( $B=-0.018$ ;  $p=0.810$ ) as well as length of surgery ( $B=0.041$ ;  $p=0.868$ ), use of an anterior plate ( $B=0.041$ ;  $p=0.868$ ) and number of levels ( $B=-0.037$ ;  $p=0.888$ ) were not significantly associated with dose area product. Although the type of head fixation did not significantly predict increases in dose area product, we could exclude the possible confounding factors such as number of levels, use of an anterior plate and length of surgery as the sole effectors of the observed differences.

We can postulate that a binary independent variable (Mayfield/Headrest) may not be strong enough an effector of dose area product to create a significant effect within the context of a linear model. Increasing sample size through future observations may provide further insights.

These findings and discussion have now been added to the manuscript.

**Changes in the text:** the results of the linear regression analysis and their discussion have been added to the manuscript (See page 6, line 162-168).

**Comment 12:** A chi-squared test is not appropriate for a comparison of adverse events (table 3) because the events are not necessarily mutually exclusive. The rates of each adverse event should be compared individually between the Mayfield and headrest groups.

**Response 12:** We thank the reviewer for pointing out this error. We have now included comparison of individual events using the Fisher's Exact Test.

**Changes in the text:** data has been added in table 3.

**Comment 13:** Were there differences in change in mRS between the Mayfield and headrest groups (table 3)? This could be displayed/analyzed in table 3 by either looking at the numeric change in mRS or simply categorizing as increased/no change/decreased.

**Response 13:** We thank the reviewer for this suggestion and have now compared pre- and postoperative mRS scores in the Mayfield and headrest groups. Here we found that there was a statistically significant difference in pre- and postoperative mRS scores in both the Mayfield group ( $Z=-4.516$ ;  $p<0.001$ ) and headrest group ( $Z= -3.222$ ;  $p=0.001$ ) indicating an improvement of mRS score following surgery.

**Changes in Text:** the new data has been added to the results section (see page 6, lines 176-181)

## **Reviewer B**

**Comment 1:** I have read the manuscript.

I rarely know of anyone who uses Mayfield head clamp for acdf.

On the contrary without head clamp will get more preop lordosis.

Don't see added value to literature.

**Response 1:** We appreciate the reviewer for taking the time to read and respond to our manuscript. In our institution, the Mayfield skull clamp was the default positioning method until 2021, which prompted us to perform this study. The Mayfield skull clamp is also described in the literature as a standard method of patient positioning for anterior cervical spine procedures (1, 2), so that we hope our study may be of interest to those who are less familiar with this form of positioning. In our experience the Mayfield skull clamp indeed allows for adequate (particularly obese patients), reclination and lordosis. Overall, our study aims at addressing a practical aspect of ACDF procedures. We hope to provide evidence for aid the decision of whether to use one particular method of positioning over another when this would otherwise have been made based on personal preference without data to back up this choice.

1. St-Arnaud D, Paquin MJ. Safe positioning for neurosurgical patients. *Can Oper Room Nurs J.* 2009;27(4):7-11, 6, 8-9 passim.

2. Cunha PD, Barbosa TP, Correia G, Silva R, Cruz Oliveira N, Varanda P, et al. The ideal patient positioning in spine surgery: a preventive strategy. *EFORT Open Rev.* 2023;8(2):63-72.

## **Reviewer C**

Some points need a revision:

**Comment 1:** Lines 84-87: "Patients were either positioned 83 using the Mayfield skull clamp or the padded headrest... mRS at last follow up" It is not clear what is the purpose of this paper. Revise this part.

**Response 1:** We have reformulated the wording in this section as advised to now clarify the aim of our study (whether the use of the Mayfield skull clamp or the padded head rest offers any benefit or disadvantage when compared to one another).

**Changes in the text:** page 3, lines 59-60 and 69-72.

**Comment 2:** In the methods section it is not clear how the 2 groups were decided. Report it here.

**Response 2:** Cases were separated into two groups depending on their recorded positioning in the Mayfield skull clamp or padded head rest. This information has now been added to the methods section.

**Changes in the text:** see page 3, lines 65-67

**Comment 3:** Lines 240-245. Improve discussion. Look at these papers to improve the text: -- doi: 10.3390/life13071564 -- doi: 10.3171/2022.6.SPINE22454

**Response 3:** We thank the reviewer for the suggested literature, which we have now incorporated into the discussion.

**Changes in the text:** See page 7, line 209-213 and page 9, lines 260-266.

**Comment 4:** Lines 271-272: "Nonetheless, efforts should be made to reduce exposure wherever possible, such as use of collimation which can also reduce exposure to the surgeon " It is not clear how the reduce exposure is related with the head positioning.

**Response 4:** We thank the reviewer for pointing out the lack of clarity in this section. This sentence is referring to the overall recommendation of attempting to reduce radiation exposure to both the surgeon and patient, with collimation being one option to do so. Our results per se indicate that head positioning in the Mayfield may be associated with lower radiation exposure. We have revised this sentence to improve clarity.

**Changes in the text:** See page 8, lines 270-271.

**Comment 5:** A conclusion section is mandatory.

**Response 5:** Using the provided manuscript template, a conclusion section was not foreseen so that we have now added a conclusion paragraph within the text.

**Changes in the text:** See page 9, lines 275-278.

#### **Reviewer D**

**Comment 1:** Introduction: Please adjust the formatting in lines 77-78 to insert a space in between these two paragraphs. Also, please edit the manuscript for grammatical changes throughout that will promote ease of read. The introduction should be inclusive of strictly background information. There should not be patient cohort information or referral to institution-based predilections. As outlined in lines 78-80. Rather, a reference to current literature should be discussed with regards to advantages and disadvantages of different patient positioning devices. The abbreviation mRS needs to be spelled out prior to utilizing it.

**Response 1:** We have adjusted the formatting as suggested and the article has been corrected by a native speaker. We have added additional references in the introduction to underscore the base of knowledge regarding patient positioning. Furthermore, we have removed any non-pertinent information from the introduction which now includes new literature on the advantages and disadvantages of the Mayfield skull clamp versus padded headrest.

**Changes in the text:** see page 2, lines 53-60.

**Comment 2:** Methods and results: Given the difference in etiology of ACDF it may be prudent to exclude traumatic and infectious etiologies. Additionally, a discussion of dose area product and its implications would be important as the total radiation time was not statistically significant between the two groups and both groups were not close to the threshold level.

**Response:** We thank the author for these suggestions. While we agree that reducing the etiologies associated with ACDF procedures would further homogenize the cohort, we believe that for the purpose of an exploratory analysis it is appropriate to include these cases. We have now addressed this aspect of our analysis in the discussion as a further limitation. In addition, we have addressed the aspect of radiation time and implications of the dose area product differences in our cohort within the discussion.

**Changes in the text:** See page 9, lines 281-283 and lines 237-241

**Comment 3:** Discussion: As stated in the discussion, with the “heterogeneous group of surgeons,” is a likely difference that could be the cause of increased radiation rather than the head rest utilized. The discussion is significantly lacking with no real attempt at delving into the findings. Rather the material is regurgitated from the results section. There are significant limitations that are not discussed in the body of the manuscript. There is rather a singular sentence discussing the limitations. A further stratification of radiation and utilization based on surgeon, and surgeon experience would shed light on whether or not these reported differences may be due to the surgeon themselves rather than the positioning device.

**Response 3:** We appreciate the feedback of the reviewer in regards to the discussion and need for improvement. We have now added information on an additional linear regression analysis performed to examine the effect of surgeon experience on the differences in dose area product which revealed no statistically significant role of surgeon experience. Furthermore, we have elaborated on several aspects in the discussion including the possibility of finding different results when including corporectomy in addition to ACDF, the possibility of different results based on surgical subspecialty performing the procedure (neurosurgery versus orthopedic surgery), linear regression analysis examining possible confounders for differences in radiation time, as well as further limitations to the study.

**Changes in Text:** See discussion page 7-9.

**Comment 4:** Overall the manuscript is lacking in its discussion of the results. Additionally, the conclusions of this article are not necessarily supported by the data. Further study and further regression analysis may be helpful in elucidating these details.

**Response 4:** we thank the reviewer for their feedback and suggestions for improving our manuscript. We have now incorporated the suggested changes, in particular to improve the

discussion. Furthermore, additional regression analysis has been performed and discussed  
**Changes in the text:** See discussion page 7-9, page 8 lines 243-248 and page 6 lines 162-168.

### **Reviewer E**

Overall, a very thorough study. The aims clearly outlined, and data well presented.

Two suggestions:

**Comment 1:** In the 11 patients being treated for "traumatic injury", can you provide specific details of the injury (e.g., level, fracture type, concomitant injuries).

**Response 1:** We thank the reviewer for the suggestion of adding this information. In our cohort there were once case each of fractures at the levels C3, C4, C5 and C6. Additional fractures involving the levels C4/5 and C5/6 occurred once each and two fractures at the level C6/7 were reported. One Hangman's fracture was included as well as two cases of traumatic disc herniation at the levels C3/4, one of which was associated with radiological signs of myelopathy. The C3 and C4 fractures as well as the HWK 4/5 fracture were in the Mayfield group.

**Changes in the text:** we have now added this information to the results section (see page 5, lines 135-141).

**Comment 2:** DAP and total radiation time was significantly higher in the headrest group, however, 8/11 with traumatic injuries were positioned in a headrest. Trauma cases would require more radiation exposure due to more imaging required. It may be worth mentioning this in the discussion.

**Response 2:** We appreciate this suggestion, which we have now included in the discussion.

**Changes in the text:** See page 8, lines 230-233.