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**Research Article**

# Postoperative Rehabilitation Comparison of Patients After Anterior Cervical Disectomy and Autograft Fusion With or Without Smoothing the Donor Site Defect

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**ABSTRACT**

**Background:** Anterior cervical discectomy and autograft fusion (ACDF) is the gold standard of surgical treatment for HNP cervical. However, donor site complication has found in the form of pain that could lead to disability. The edge of the donor site defect can initiate pain may reduce patient's quality of life. High ambulation can be earned by smoothing the donor site defect. **Objective:** The purpose of this study is to determine the quality of patient rehabilitation after ACDF with autograft between smoothing group and non-smoothing group. **Methods:** This cross-sectional study was conducted at the Adenin Adenan Hospital Medan. Patients who had undergone ACDF with autograft in 2015–2020 were assessed for their disability at the first, third, and sixth months postoperatively using Barthel Index. Total sampling method was used with inclusion and exclusion criteria. **Results:** There were 41 respondents in this study, 20 people in the non-smoothing group and 21 people in the smoothing group. The disability experienced by the smoothing group was less than the non-smoothing group at each month of measurement, but only significant ($p<0.05$) at the sixth month. **Conclusion:** Conclusions of this study was disability and rehabilitation outcomes in the smoothing group were better than in non-smoothing group.

**Keywords:** ACDF, autograft, cervical HNP, disability, rehabilitation

## 1. Introduction

HNP cervical is the protrusion of the nucleus pulposus compress the cervical spinal root and/or spinal cord, which generally happen between the age of 30-50 [1]. Almost 70% incidence of HNP cervical located at C6-C7 regio [2]. The common clinical sign of this disease is neurological deficit named cervical radiculopathy and myelopathy [3].

Anterior cervical disectomy and autograft fusion (ACDF) from the iliac crest bone is the gold standard of surgical treatment for radiculopathy and myelopathy in HNP cervical [4]. This surgical method consists of two main processes, which is disectomy by excising the collapsed intervertebral cervical disc, then placing the graft to stabilize the cervical vertebrae by fusion [5]. This surgical method was reported with a high success rate and excellent long-term outcomes [6].

Even though having excellent clinical results, the ACDF with autograft surgical method also can lead to fatal complications which are named donor site morbidity [7]. The incidence rate of this complication is around 4-39% with the highest reported case is pain. The donor site defect which injures surrounding tissues is a pathological condition after bone graft removal from the iliac crest, activated the nociceptor [8].

This pain can cause the patient's ambulation to decrease and leads to disability in the form of restrictions and difficulties in doing the activity of daily living (ADL) [9]. A rehabilitation process is needed to restore

this disability. WHO defines rehabilitation as a person-centered intervention which needed when a person experiences limitations in doing ADL [10].

The smoothing method is applied to smooth out the sharp defect in the iliac bone after harvesting the graft so as minimize tissue injury. This method is expected to have an impact on pain reduction and disability change as well as the individual rehabilitation process. This study aims to define the differences of disability and rehabilitation experienced by patients with cervical herniated disc postoperatively using ACDF with autograft method between smoothing and non-smoothing group at the donor site.

## 2. Methods

This observational study with cross-sectional design was conducted in Adenin Adenan Hospital Medan from September until October 2020. The data were primary data obtained from patient interviews by telephone and secondary data in the form of the patient's medical record.

The total sampling technique with inclusion and exclusion criteria was applied for sampling. The inclusion criteria in this study were patients with cervical herniated disc who underwent ACDF with autograft surgery from January 2015 to April 2020 at Adenin Adenan Hospital Medan. Meanwhile, patients who had died, could not be contacted, and had comorbid that caused disability were excluded from this study. The collected data were then grouped and analyzed using the SPSS (Statistical Package for Social Science) program.

T independent test, Kolmogorov-Smirnov, Chi-square, and Mann Whitney test used to see the significant characteristics differences between these two groups. Data in this study were not normally distributed so the Mann Whitney test was used to see the differences in disability and rehabilitation between the two groups and the Friedman test to see the rehabilitation of the two groups.

## 3. Results

There were 41 respondents in this study, 20 respondents in the non-smoothing group and 21 respondents in the smoothing group.

Table 1 shows the two groups of patients were dominated by the age range of 35-54 years old (51%) and 55-74 years old (36,6%), which almost the same proportion between man and woman. Based on Asia-Pacific criteria, the body mass index of both groups was dominated by obese (70% in non-smoothing group and 61,9% in smoothing group) followed by overweight (30% in non-smoothing group and 19% in smoothing group).

Data in Table 1 describes that 80% of patients of both groups had no comorbidity. In the non-smoothing group, 4 respondents (20%) had comorbidities, such as diabetes mellitus and/or with hypertension. In the smoothing group, 3 respondents (14,3%) had cardiac disease, and 1 respondent (4,7%) had dyspepsia. Statistical analysis was used to see whether there were significant differences between the two groups regarding the characteristic variable. The data in Table 1 do not show a statistically significant difference between the two groups regarding the characteristic variable, except for the sex variable (p=0,019) which has a significant difference.

**Table 1.** Respondent's characteristic

| Characteristics | Non-smoothing group (n=20) | | Smoothing group (n=21) | | p value |
|---|---|---|---|---|---|
| | N | % | N | % | |
| Range Age[a] (mean±SD) | (51.05±10.8) | | (54.62±14.3) | | |
| ≤34 | 1 | 5 | 1 | 4.8 | |
| 35-54 | 11 | 55 | 10 | 47.6 | 0.377 |
| 55-74 | 8 | 40 | 7 | 33.3 | |
| ≥75 | 0 | 0 | 3 | 14.3 | |
| Sex[b] | | | | | 0.019 |
| Male | 6 | 30 | 14 | 66.7 | |
| Female | 14 | 70 | 7 | 33.3 | |
| Body Mass Index[a]* (median (min. – max.)) | 24.97 (23.43-35.56) | | 26.22 (17.10-34.31) | | 0.230 |
| *Underweight* (<18,5 kg/m$^2$) | 0 | 0 | 1 | 4.8 | |

| | | | | | |
|---|---|---|---|---|---|
| *Normoweight* (18,5-22,9 kg/m$^2$) | 0 | 0 | 3 | 14.3 | |
| *Overweight* (23-24,9 kg/m$^2$) | 6 | 30 | 4 | 19 | |
| *Obese* (≥25 kg/m$^2$) | 14 | 70 | 13 | 61.9 | |
| Comorbidity[a]** | | | | | |
| None | 16 | 80 | 17 | 81 | 1.000 |
| DM | 2 | 10 | 0 | 0 | |
| Cardiac disease | 0 | 0 | 3 | 14.3 | |
| DM dan Hypertension | 2 | 10 | 0 | 0 | |
| Dyspepsia | 0 | 0 | 1 | 4.7 | |

[a] $p > 0.05$, comparison of two groups with independent t-test, Mann Whitney and Kolmogorov-Smirnov
[b] $p < 0.05$, comparison of two groups with chi-square
*BMI score cut-off based on Asia-Pacific criteria
**Patient's comorbidity before ACDF surgery and 6 (six) months postoperatively

**Table 2.** Patient's disability score based on barthel Index

| Indeks Barthel | Non-smoothing group (n=20) | Smoothing group (n=21) | p |
|---|---|---|---|
| 1st month | 67.50 (20-100) | 85.00 (30-100) | 0.196 |
| 3rd month | 92.50 (20-100) | 100 (35-100) | 0.333 |
| 6th month | 100 (20-100) | 100 (35-100) | 0.035 |

Data in median (min.-max.)

Data in Table 2 shows the median score of patient's disability for each month measurements using the Barthel Index. In the non-smoothing group, the median IB score on the first month was 67,50, the third month was 92,50, and the sixth month was 100. Meanwhile, in the smoothing group, the median IB score on the first month was 85, the third and sixth month was 100. Measurements of patient's disability scores (Index Barthel score) were compared between the two groups each month using Mann Whitney test. From the data in Table 2, it is known that the result of the disability score analysis on the first (p=0,196) and third (p=0,333) months show p-value >0,05, which means that there is no significant difference in disability between the two groups. The statistical analytical result on the sixth month after ACDF with autograft surgery shows that p-value (0,035) <0,05 which means that there was a significant difference in disability between these two groups.

**Table 3.** Respondent's characteristic

| | N | $\chi^2$ | p |
|---|---|---|---|
| Non-smoothing group | 20 | 23.522 | 0.000 |
| Smoothing group | 21 | 24.500 | 0.000 |

The patient's rehabilitation was seen from the change in the Barthel Index score each month of measurements. Barthel Index score of 12 patients (60%) in the non-smoothing group increased on every month of measurement and 40% of patients had no change. In this group, 50% of patients had the greatest improvement in the Barthel Index score between the first and third months postoperatively and the other 50% of patients either had the greatest increase score between the third and sixth month or had no change.

In the smoothing group, the Barthel Index score of 14 patients (66,67%) increased on every month of measurement and the 7 other patients (33,33%) had no change. In this group, 52,4% of patients had the greatest improvement in the Barthel Index score between the first and third months postoperatively, meanwhile, 47,6% others either had the greatest increase score between the third and sixth months or had no change.

Patient's Barthel Index score in the first, third and sixth months after surgery for each group were analyzed using the Friedman test to see if there was a rehabilitation process that displayed a statistically significant change in score. From the data in Table 3 above, it is found that the p-value in the Friedman test results for both groups is 0,000 (<0,05), which means that there is a significant change in disability score.

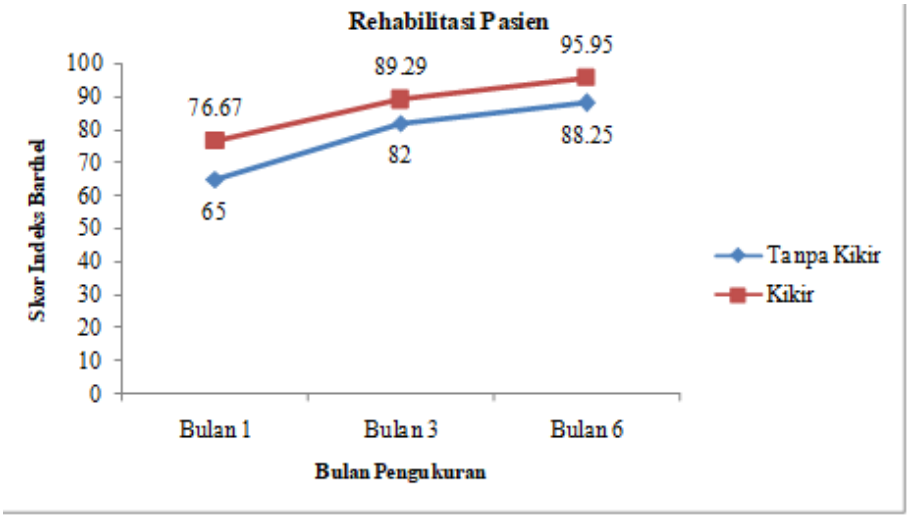


**Figure 1.** Patient's Rehabilitation Chart

Figure 1 shows the mean Index Barthel score change in the two groups. Each group showed an increase in the average score each month of measurement. The highest score increase was experienced by the non-smoothing group between the first and third month, which is 17 points. Meanwhile, in the group with donor filing, it was just 12,6 points. In contrast, between the third and sixth months, the average increase of Barthel Index score slightly higher in the smoothing group (6,66 points) rather than the non-smoothing group (6,25 points). Comparison of rehabilitation of the two groups was obtained by comparing the difference in Barthel Index scores (IB scores at sixth month – IB scores at first month) for each patient in each group. This difference was compared statistically using the Mann Whitney test. It was found that the difference in rehabilitation between the two groups was not significant, p (0,689) > 0,05.

## 4. Discussion

Based on the data in Table 1, most of the sample (87,8%) of this study were in the age range 35-54 years old and 55-74 years old with an average age is 52,8 years old. There were slightly more female patients (51,2%) than men (48,8%). In a study by Burkhardt and friends regarding the application of the ACDF with autograft technique for cervical disc herniation, the study sample was in the age range 26-61 years old but was dominated by men (60,7%) [11]. Pollock and friends in 2008 reported that the number of males was equal to the number of females (12 persons) with the age range of 14-61 years old when taking the SIAS for cervical fusion [12]. Heindel and friends in their study of chronic morbidity after bone graft harvesting from SIAS for cervical fusion with the Pilot Hole Burr technique reported that the mean age of patients at surgery was 52 years old with the population of females (56,6%) was more than man (43,4%) [13]. The previous studies mentioned above are consistent with this study where patients who underwent ACDF with autograft surgery were in the age range 35-74 years old with almost the same proportion between men and women. This could also be related to the incidence of cervical HNP, as the indication of ACDF with autograft surgery in this study, which is common in the age 30 to 50 years old and initially, men had a higher risk of developing HNP but recently, women are predicted to have a higher risk [14, 15].

Based on Body Mass Index (BMI) data in Table 1, the majority of patients (90%) in this study were classified as obese and overweight according to Asia-Pacific criteria. In this study, only 19,5% of the sample had comorbidity, mostly diabetes mellitus and/or with hypertension, followed by cardiac disease (history of coronary stenting) and dyspepsia. The results of this study are consistent with the study of Dharmajaya and friends, which tells those patients who underwent ACDF with autograft from the iliac bone were predominantly overweight and obese [16]. This research is also in line with a study conducted by Teo and friends in the Asian population regarding the relationship between body mass index and long-term outcome of ACDF surgery which states that the population is dominated by patients in the obese and overweight

category. Comorbidities were found in 21,8% of patients, which were diabetes mellitus and ischemic heart disease [17].

The analysis results of characteristics differences (age, sex, BMI, and comorbidity) did not show statistically significant differences between the two groups except for the sex variable (p=0,019) which had a significant difference. This shows that the difference in the Barthel Index score between the two groups is not influenced by age, body mass index, and comorbidities. The disability in this study referred to the limitation in doing the daily activity (Activity of Daily Living) which is caused by pain arising from tissue injury by the sharp defect at the site of bone graft harvesting. This disability is measured by the Barthel Index. The higher the Barthel Index score, the lower the patient's disability.

Disability experienced by the postoperative ACDF with autograft patients has previously been reported in several studies. Silber and friends studied the donor site morbidity after iliac bone graft harvesting for ACDF surgery. Of the 134 patients, approximately 50,7% of patients had difficulty in ambulation in the acute phase (first three months after surgery) and 5,2% of patients had difficulty in dressing in the chronic phase (>3 months after surgery) due to the pain after bone graft harvesting. Based on general functional assessment, 12,7% of patients had difficulty in ambulation, 6,7% of patients had difficulties and limitations in doing daily activities (ADL), and 8,2% of patients had difficulties in doing household chores [9]. Pollock and friends found that of the 24 patients who underwent iliac bone graft harvesting for cervical fusion with an open technique, 54,6% of patients had difficulty in ambulation and 19% of patients had to use a walker after surgery [12]. Burkhardt and friends in 2017 said that 9,8% of cervical HNP patients experience limitations in daily activities such as walking, self-care, and doing homework after anterior cervical disectomy with autograft fusion surgery [11]. Heindel and friends divided the donor site morbidity into acute and chronic morbidity in his study of the application of the Pilot Hole Burr technique to harvest the iliac bone for cervical fusion. Disability was only found in the chronic morbidity, in which 1,9% of patients experienced functional impairments, ambulation difficulties, and difficulties performing ADL due to the pain at the site of bone graft harvesting [13].

The four studies above are in accordance with this study. In this study, disability was found in the form of limitations in doing daily activities related to the donor site pain in both groups, which can be seen from the low median Barthel Index score on the first month after ACDF with autograft surgery (Table 2). The researcher found that in the first three months post-ACDF with autograft surgery, both groups tended to complain of difficulties in doing activities that require balance, flexibility, and changes in place such as moving from supine to sitting position, going in and out of the toilet, dressing, mobilizing, and going up and downstairs. By the sixth month, the disability of 90% of patients in this study was not significant (IB=80-100).

Data in Table 2 shows that p-value <0,05 was only found at the sixth month after surgery (p=0,035) which means that a significant disability difference between the smoothing and non-smoothing group was only found at the sixth month. The researcher considered that this significant difference was derived from the differences in the types of activity limitations experienced by the two groups of patients at the sixth months after surgery. The smoothing group tended to experience limitations in doing the same activities as in the first and third months, which were difficulty in dressing, moving from supine to sitting position, and going in and out of the toilet. In contrast to the smoothing group, the non-smoothing group tended to experience restrictions dan difficulties in doing the different type of activities from the first and third months, that was difficulty in going up and downstairs, moving from supine to sitting position, and difficulty controlling defecation. Besides, in the smoothing group, only one patient (4%) had severe disabilities (IB=35) until the sixth month, while in the non-smoothing group, there were three (15%) patients who needed assistive devices to walk until now, two people need a cane and one person uses a wheelchair.

Several previous studies have reported the relationship between BMI and disability. Data obtained from American Association on Health and Disabilities states that 20% of the adult population who are underweight and 30% of the adult population who are obese have a disability [18]. In the study conducted by Teo and friends, there was no difference in operative outcomes and recovery rates experienced by post-ACDF patients related to body mass index [17]. Likewise in the research of Narain and friends in 2017 stated that there were no differences in the operative outcomes, the use of narcotics, and the total hospital costs related to BMI in postoperative ACDF patients [19]. This study did not seek the relationship between BMI and disability in the two groups. However, from the analysis results, there was no statistically significant difference in the BMI variable between the two groups, so it can be concluded that the difference in disability between the two groups was not influenced by the BMI.

Rehabilitation in this study was defined as the recovery process of a patient after surgery to normal daily functions. Rehabilitation of each group was seen based on changes in disability (Barthel Index score) each

month of measurement. The majority of patients from both groups in this study experienced the greatest increase in Barthel Index score (disability reduction) between the first and third months after ACDF with autograft surgery. This result is similar to the research of Coronado and friends in 2019 which showed that 62,5% of patients experienced the greatest reduction in disability in the first six weeks after ACDF surgery [20].

Based on the data in Table 3, it was found that the p-value from the Friedman test in both groups is 0,000 (<0,05), which means that there is a significant change in disability scores between the first, third, and sixth months postoperatively. This proves that there is a rehabilitation process in both groups of patients. From the patient's rehabilitation chart (Figure 1) and the description in the result section above, the researcher found that the rehabilitation process for the non-smoothing group was better than the smoothing group because the mean Barthel Index score increase of the non-smoothing group was higher than that in the smoothing group, but this is not statistically significant. Although the rehabilitation process of the non-smoothing group was slightly better, the average monthly Barthel Index score of the patients in the smoothing group was better than that of the non-smoothing group. This shows that the disability in the smoothing group was minimal and the final result of the rehabilitation process in this group was also better when compared to the non-smoothing group. The researcher attributed this incident to the application of the smoothing method to the donor site. This method smooths the sharpness at the donor site defect after graft harvesting, so that there is no trigger of pain around the bone harvesting site. This pain reduction will make the patient more comfortable or brave to move and avoid prolonged disabilities after surgery so that the rehabilitation process also produces a better outcome.

## 5. Conclusion

The disability experienced by patients in the smoothing group was lower than in the non-smoothing group which is proven by the higher average Barthel Index score in the smoothing group each month of measurement. It can be concluded that the smoothing method in ACDF surgery can significantly reduce the patient's disability on the sixth months after surgery. The rehabilitation process in the non-smoothing group was better than the smoothing group, but it was not statistically significant. However, the final rehabilitation outcomes of the smoothing group were better than the non-smoothing group.

## 6. Data Availability Statement

The datasets generated and analyzed during the current study are not publicly available due to privacy and ethical considerations but are available from the corresponding author upon reasonable request.

## 7. Ethical Statement

Sumatera Medical Journal (SUMEJ) is a peer-reviewed electronic international journal. This statement clarifies ethical behavior of all parties involved in the act of publishing an article in Sumatera Medical Journal (SUMEJ), including the authors, the chief editor, the Editorial Board, the peer-reviewer and the publisher (TALENTA Publisher Universitas Sumatera Utara). This statement is based on COPE's Best Practice Guidelines for Journal Editors.

## 8. Author Contributions

All authors contributed to the design and implementation of the research, data analysis, and finalizing the manuscript.

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## 11. Conflict of Interest

Authors declares no conflict of interest.

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