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*Original Article*

# Effects of the direct anterior approach and Orthopadisehe Chirurgie Munchen on early joint function after primary hip arthroplasty in young adults

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**Abstract:** Objective: To compare the effect of Direct Anterior Approach (DAA) and Orthopadisehe Chirurgie Munchen (OCM) in the prone position on early joint function after primary hip arthroplasty in young adults. Methods: In this retrospective analysis, 85 patients who received primary hip arthroplasty between September 2018 and January 2020 were enrolled and divided into the OCM group (43 cases with OCM) and the DAA group (42 cases with DAA) according to the different surgical methods. The general operative conditions, postoperative conditions and imaging manifestations, postoperative pain, changes in WOMAC scale scores, and the occurrence of adverse reactions were compared between the two groups. Results: The operation time of the OCM group was shorter, and the blood loss and drainage volume in the OCM group during the operation were lower than those of the DAA group ($P$<0.05). The time spent in bed and hospital stay of the OCM group were shorter than those of the DAA group ($P$<0.05). The anteversion and abduction angles of patients in the OCM group were smaller than those in the DAA group at 1 month after surgery ($P$<0.05). There was no significant difference in visual analogue scale (VAS) scores between the two groups at day 1, 3 and 7 after surgery ($P$>0.05). At 1 month after surgery, patients in the OCM group had lower pain level and higher activity level than the DAA group ($P$<0.05). The activity score in the OCM group was higher than that in the DAA group ($P$<0.05). There was no statistically significant difference in WOMAC scores between the two groups at 1 year after surgery ($P$>0.05). The total incidence of adverse reactions within 7 days after surgery in the OCM group was lower than that in the DAA group ($P$<0.05). Conclusion: Compared with the DAA group, the OCM group had shorter operative time, quicker recovery after surgery, and lower postoperative pain scores. In the long term, these two surgical methods showed little difference in hip joint function recovery.

**Keywords:** Direct anterior approach, Orthopadisehe Chirurgie Munchen, modified anterolateral approach, hip arthroplasty, early postoperative function

## Introduction

The hip joint is a ball-and-socket joint made up of the femoral head and acetabulum [1] that allows motion and provides stability needed to support weight. Hip-related diseases such as femoral head necrosis, hip dysplasia, and degenerative hip arthritis seriously affect the quality of life of patients, and some patients may even develop life-threatening thrombosis [2, 3].

Hip arthroplasty is an effective surgical method in the treatment of osteoarthritis, rheumatoid arthritis, traumatic arthritis, femoral head necrosis, congenital hip dysplasia, femoral head necrosis, and femoral neck fracture, *etc*. [4], and it is the second most commonly used surgery in Western countries after cholecystectomy. In recent years, with the global aging trend and the increase of the incidence of autoimmune diseases, the clinical application rate of hip arthroplasty has been increasing annually [5]. Clinical studies show that hip arthroplasty was introduced in China in the 1970s and widely applied in clinical practice in the 1990s. After decades of development, hip arthroplasty is implemented in 200,000 cases per year in China, which plays an important role in improving the quality of life and reducing the disability rate of patients [6, 7]. The Direct Anterior Approach (DAA) is a minimally invasive approach

developed in recent years, which is performed through the muscle interval between the tensor fasciae latae and the rectus femoris, avoiding injury of single muscle tissues by conventional surgery, and presenting the advantages of less injury and high joint stability [8]. DAA is an intermuscular approach, which simultaneously enters from different nerve planes, leading to reduced trauma to the patient and lower risk of postoperative dislocation. Since the patients are in the supine position, the surgeon can more conveniently perform fluoroscopy during the operation to master the position of the prosthesis, but the disadvantage is poor lateral exposure of the femur, which is not suitable for femoral revision surgery. Orthopadisehe Chirurgie Munchen (OCM) is a modified surgery based on DAA [9]. Compared with DAA, OCM can better expose the fracture end, allowing for easier access intraoperatively, resulting in reduced trauma to patients and lower incidence of postoperative complications, but its disadvantage is that it may cause certain damage to the external rotators, and patients may have a high probability of postoperative dislocation. There are no clinical studies comparing the advantages and disadvantages of OCM and DAA in hip arthroplasty. Therefore, this study was designed to investigate the effect of DAA and OCM in the prone position on early joint function after primary hip arthroplasty in young adults. It was found that compared with DAA, OCM had a shorter operative time and faster recovery of hip function in the early stage, but there was little difference between the two methods in the long term.

## Materials and methods

### *General data*

In this retrospective analysis, 85 patients underwent primary hip arthroplasty in our hospital between September 2018 and January 2020 were enrolled and divided into the OCM group (43 cases with OCM) and the DAA group (42 cases with DAA) according to the different surgical methods.

*Inclusion criteria:* (1) patients who received primary hip arthroplasty; (2) patients without previous history of hip surgery; (3) patients with good hip mobility; and (4) patients with complete medical records. The study was approved by the ethics committee of Xianning Central Hospital (No. NCT02359634).

*Exclusion criteria:* (1) patients combined with active infections; (2) patients combined with psychiatric disorders; (3) patients combined with malignant tumors; (4) patients combined with malignant tumors; (5) patients combined with serious medical diseases; (6) patients combined with coagulation disorders; (7) patients combined with autoimmune system disorders; (8) patients who received long-term treatment with corticosteroids; (9) patients combined with spinal disorders affecting lower limb activities; and (10) patients with body mass index (BMI) >30 kg/m$^2$.

### *Intervention method*

All patients received routine preoperative X-ray examination to determine the size of the acetabulum and femoral prosthesis as well as the level of femoral neck osteotomy. Patients underwent preoperative routine skin preparation and catheter indwelling, and general or spinal anesthesia was performed depending on the patient's condition. The patients in the DAA group were placed in a lateral position after anesthesia, and incisions were made on the lower lateral sides of the anterior superior iliac spine. The skin and tissue were cut layer by layer. The fascia latae and the underlying muscles were separated, and the rectus femoris and fascia latae were separated, followed by exposing the joint capsule, removing the femoral head and fractured neck after opening the joint capsule. The acetabulum was polished to create fresh blood leakage, and the hip joint was reset after femoral head prosthesis. The stability of the hip joint as well as the level of flexion and extension was checked. The incision was sutured after placement of the negative pressure drainage tube. In the OCM group, an incision of 8 cm in length was made 6 cm behind the anterior superior iliac spine toward the most prominent point of the greater trochanter, and the muscles and deep fascia were cut layer by layer. The interval between the platysma and gluteus medius was opened at the front edge of the gluteus medius, and the femoral head and neck were removed after the sac was incised. The drainage tube was placed after the prosthesis was implanted, the incision was sutured, and routine antibacterial treatment was performed after surgery.

### *Outcome measurements*

*Primary indicators:* (1) Postoperative imaging performance. The anteversion and abduction

angles at 1 month postoperatively were measured. The abduction angle is the angle between the highest point of acetabular margin and the lowest point of superior pubic ramus and ischial tuberosity. Anteversion angle: After the prosthesis was installed and reduced, the anterior and posterior positions of the hip were examined by X-ray to obtain the elliptical metal ring or metal cup arc. The maximum diameter of the ellipse formed by the cup was measured. Starting from the midpoint of the maximum diameter, a vertical line was made to the arc surface or the ellipse orbit. The distance between the intersection point and the midpoint was set to r, and the minimum diameter of the ellipse was set to d. The angle between the cup plane and the sagittal plane was calculated according to the law of sines. (2) Preoperative and postoperative WOMAC scale [11] scores. The WOMAC scale was used to assess the joint function of patients at multiple time points, including before surgery, at postoperative 1 month, 6 months and 12 months, respectively. The WOMAC scale included three dimensions of pain, stiffness, and joint function, with a total of 24 items. A score of <80 indicated mild symptoms, 80-120 indicated moderate symptoms, and >120 indicated severe symptoms. (3) Incidence of perioperative adverse reactions. The incidence of perioperative adverse events such as femoral nerve injury, prosthesis sinking and thrombosis were compared between the two groups.

*Secondary indicators:* (1) General surgical condition. Three indicators of general surgical condition including operative time, intraoperative blood loss and postoperative drainage were recorded. (2) Postoperative condition. Time spent in bed, hospital stay, and C-reactive protein (CRP) level at postoperative day 3 were recorded and measured. (3) Postoperative pain level. Visual analog scale (VAS) score was used to evaluate the pain level of patients at day 1, 3 and 7 postoperatively [10] (ranging 0-10, with a score of 0 representing no pain and 10 representing severe pain, and the subject reported a score to represent his or her pain level based on his or her condition).

*Statistical methods*

SPSS 22.0 statistical software was adopted for data analysis. Measurement data were expressed as (mean ± standard deviation). T-test was used for inter-group comparison of data conforming to a normal distribution, whereas Mann-Whitney U-test was applied for data with variance inconsistency. Chi-square test was used for inter-group comparison of counting data. To analyze the differences among multiple time points in the two groups, variance of analysis followed with LSD test was performed. The difference was considered statistically significant when $P<0.05$. GraphPad Prism 8.3 was used for illustrating figures [12].

## Results

*Comparison of baseline data*

Baseline data such as gender, age, weight, BMI, and lesion type showed no statistically significant difference between the two groups ($P>0.05$), suggesting that the two groups were comparable (**Table 1**).

*Comparison of the general surgical conditions*

Patients in the OCM group had shorter operation time and lower intraoperative blood loss and drainage than those in the DAA group ($P<0.05$), suggesting that OCM surgery caused less damage to patients (**Figure 1**).

*Comparison of the postoperative conditions*

Patients in the OCM group had shorter time spent in bed and hospital stay than those in the DAA group ($P<0.05$). However, the difference in postoperative CRP levels was not statistically significant between the two groups ($P>0.05$), suggesting that the OCM group had a faster postoperative recovery, but the difference in postoperative inflammatory response was not statistically significant between the two groups ($P>0.05$) (**Figure 2**).

*Comparison of postoperative imaging results*

The anteversion and abduction angles of patients in the OCM group were smaller than those in the DAA group ($P<0.05$), suggesting that the level of joint movement in the DAA group was better than that in the OCM group in a short time after surgery (**Figures 3** and **4**).

*Comparison of postoperative pain levels*

The difference in VAS scores was not statistically significant between the two groups at day 1, 3 and 7 after surgery ($P>0.05$), suggesting that there was no significant difference in the postoperative pain levels between the two groups (**Figure 5**).

**Table 1.** Comparison of baseline data ($\chi \pm s$)/[n (%)]

| Baseline data | | OCM group (n=43) | DAA group (n=42) | $t/X^2$ | $P$ |
|---|---|---|---|---|---|
| Gender | Male | 26 | 27 | 0.132 | 0.716 |
| | Female | 17 | 15 | | |
| Mean age (Y) | | 30.29±2.11 | 30.34±1.98 | 0.113 | 0.91 |
| Mean weight (kg) | | 70.19±2.39 | 69.98±3.01 | 0.357 | 0.722 |
| Mean body mass index (kg/m$^2$) | | 22.08±2.10 | 22.03±1.98 | 0.113 | 0.91 |
| Lesion type | Femoral head necrosis | 3 | 4 | 0.334 | 0.716 |
| | Hip dysplasia | 13 | 14 | | |
| | Fracture of the neck of the femur | 20 | 19 | | |
| | Femoral arthritis | 7 | 5 | | |
| With or without medical insurance | Yes | 40 | 40 | 0.188 | 0.664 |
| | None | 3 | 2 | | |

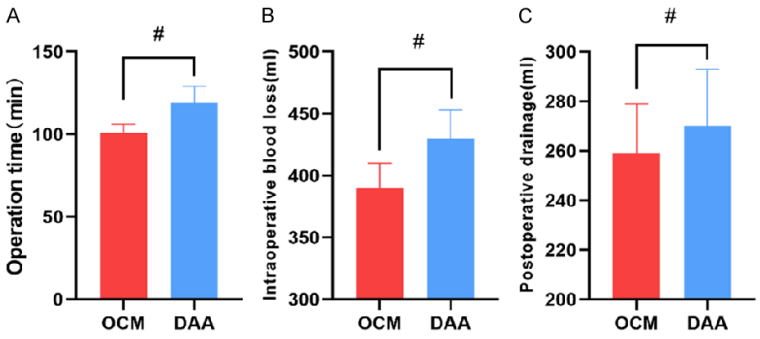


**Figure 1.** Comparison of general surgical conditions. A: Operative time; B: Intraoperative blood loss; C: Drainage. #$P$<0.05 compared with DAA group. t test was adopted.

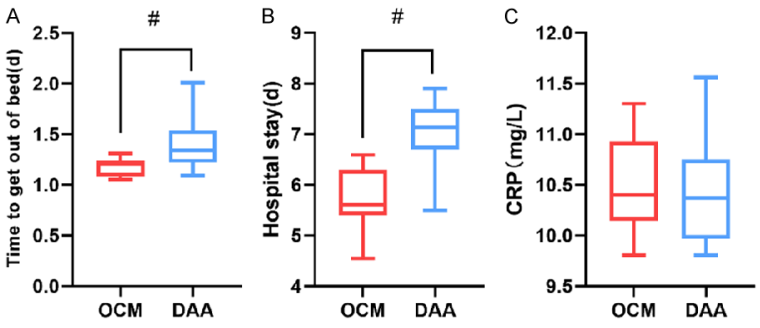


**Figure 2.** Comparison of postoperative conditions. A: The time spent in bed; B: Hospital stay; C: CRP levels. #$P$<0.05 compared with DAA group. t test was adopted.

*Comparison of preoperative and postoperative WOMAC scale scores*

The difference in WOMAC scores was not statistically significant between the two groups before surgery ($P$>0.05). At 1 month after surgery, the pain score of the OCM group was lower and the level of mobility was higher than that of the DAA group ($P$<0.05). At 6 months after surgery, the score of the OCM group was higher than that of the DAA group ($P$<0.05). At 1 year after surgery, there was no significant difference between the two groups in each item of WOMAC scale ($P$>0.05) (**Figure 6**).

*Comparison of the incidence of adverse reactions*

The total incidence of adverse reactions such as femoral nerve injury and limb subsidence was 6.98% in the OCM group and 23.81% in DAA group at postoperative day 7, and the difference in the total incidence of adverse events between the two groups was statistically significant ($P$<0.05) (**Figure 7**).

## Discussion

The incidence of hip diseases such as hip osteoarthritis, femoral head necrosis, and femoral neck fracture is increasing in recent years [13]. Studies have analyzed that the reason may be related to the aging trend of society [14], and high incidence in young patients may be related to immune disorders and genetic factors [15]. Hip diseases can significantly affect the daily life of

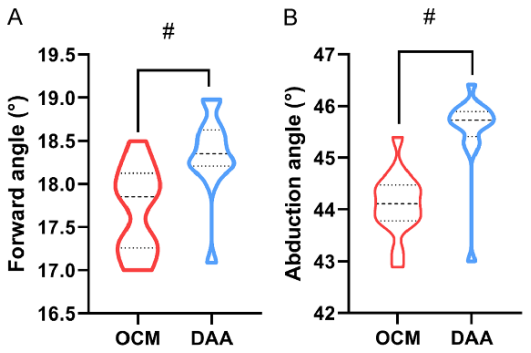


**Figure 3.** Comparison of postoperative imaging. A: Anteversion angle; B: Abduction angle. #*P*<0.05 compared with DAA group. t test was adopted.

patients, and even lead to limb deformity or disability in severe cases. Therefore, early intervention is recommended [3]. Currently, surgery is the main clinical treatment for hip diseases, and total hip arthroplasty has a definite curative effect, but some data show that its success rate is only about 80%, which may be associated with the surgical approach [16]. DAA and OCM are common in total hip arthroplasty. DAA is a modification of the Smith-Petersen approach, which enters through tensor fascia latae, sartorius muscle and rectus femoris muscle during the operation without cutting muscle tissue, while preserving joint capsule and external rotators, which greatly reduces the incidence of postoperative joint dislocation [17]. OCM is a modification of DAA, and the approach is between the gluteus medius and the broad fascial tensor fasciae, which also eliminates the muscle being cut and preserves joint capsule and tendons, leading to faster postoperative recovery [18].

In this research, it was found that patients in the OCM group had shorter operation time, time spent in bed, and hospital stay than those in the DAA group, and intraoperative blood loss as well as drainage in the OCM group were lower than those in the DAA group, which was in line with the findings of other scholars. Similarly, studies have confirmed that OCM surgery is performed based on DAA surgery, which is an emerging minimally invasive surgical approach, avoiding damage to muscle tissue compared with the conventional surgery, resulting in faster postoperative recovery and higher joint stability [19, 20]. Another comparative study of patients undergoing DAA surgery and those undergoing the conventional posterolateral approach (PA) showed that patients with DAA had significantly smaller intraoperative incision, lower the postoperative complication rate, and lower Harris score of the hip at 1 month after surgery than those with PA; and the scholars believed that DAA could minimize the damage to soft tissues and did not damage the hip capsule, which resulted in a lower rate of joint dislocation and shorter recovery time [21]. The results of this study confirmed that patients in the OCM group had significantly shorter postoperative hospital stay, and the imaging examination conducted 1 month after surgery also showed that the postoperative anteversion and abduction angles of patients in the OCM group were smaller than those of patients in the DAA group, which is a common clinical indicator of hip joint stability in clinic, and this result confirmed that the postoperative joint stability of patients in the OCM group was better, and their risk of joint dislocation would be lower. This is different from the research results of the above scholars. The authors of the present study attributed it to the fact that DAA is improved on the basis of PA, which has the advantages of less injury and faster postoperative recovery, while OCM is developed on the basis of DAA, which is further modified compared with DAA, so it has greater advantages in terms of surgical injury and impact on joint function [22]. At the same time, OCM patients had a faster postoperative rehabilitation process, which may be related to reduced trauma to the patient during the operation on the one hand, and on the other hand, it may also be related to the higher joint stability of the patients after OCM, thus speeding up the rehabilitation process. However, the authors of this article believed that OCM also has some disadvantages. For example, OCM is more difficult to operate and requires a higher level of the operator, and it is not suitable for some obese patients with abnormal hip joint. Therefore, it should be chosen dialectically in clinic [23].

The findings showed that the difference in VAS scores was not statistically significant between the two groups at day 1, 3 and 7 after surgery, which was probably due to the fact that both surgeries were invasive, and the follow-up time was too short. This is evidenced by the fact that the OCM group scored lower than the DAA group on the WOMAC scale at 1 month postoperatively, suggesting that OCM had a higher advantage over DAA at 1 month postoperative-

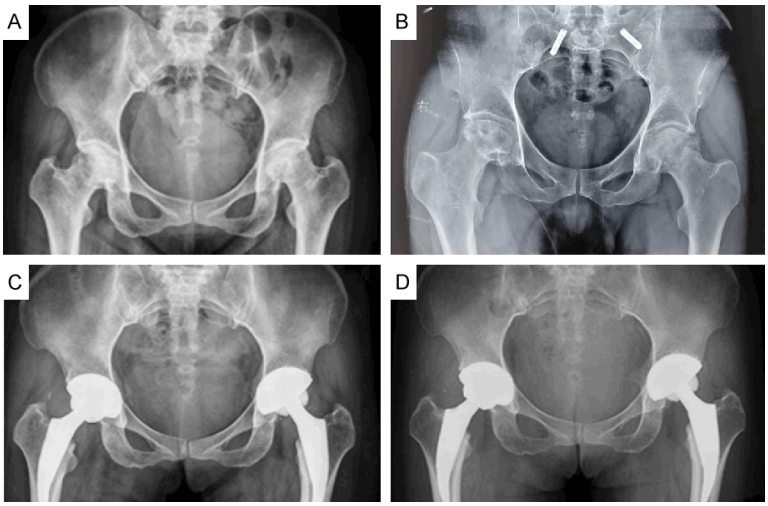


**Figure 4.** Preoperative and postoperative images of patients in DAA and OCM groups. A: Image of DAA group before surgery; B: Image of OCM group before surgery; C: Image of DAA group after surgery; D: Image of OCM group after surgery.

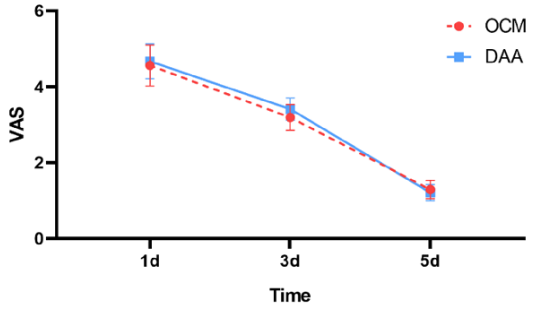


**Figure 5.** Comparison of postoperative pain levels. Variance of analysis was adopted, followed by LSD test.

ly, and patients with OCM surgery had less postoperative pain and better recovery than those with DAA. Patients in the OCM group had better joint mobility than those in the DAA group in a short time after surgery, as mentioned in studies by other researchers [24]. A controlled study of 80 patients with hip arthroplasty showed that Harris scores in the OCM group were significantly higher than those in the DAA group at postoperative 3 and 6 months (86.63±1.69 vs. 80.78±4.30) (96.19±3.22 vs. 91.28±4.01) [25], which was similar to the results of the present study. The reasons may be attributed to the fact that OCM surgery causes less damage to the soft tissues and preserves the intact structure of the joint capsule as well as the tendons, which is reflected in the difference in the postoperative complication rate between the two groups. At 12 months after surgery, there was little difference between DAA and OCM in terms of hip function, and the reason may be that the long term joint function is not only related to the surgical procedure, but also closely related to the rehabilitation process and lifestyles of the patients.

The innovation of this study was the comparison of two new hip arthroplasty approaches, DAA and OCM, and the analysis of the immediate and long-term effects on the hip function of patients. The limitation of this study was that on the one hand, it did not explore the effects of different rehabilitation measures and lifestyle habits on joint function, and the results may have some bias; on the other hand, the two surgical procedures were evaluated only from objective indicators in this study, and the specific postoperative experience, satisfaction and other aspects were not quantitatively evaluated from the perspective of the patient, which deviated from the theme of patient-centeredness; third, the relatively small number of included cases in young patients and the relatively simple cause of the disease may also have a certain impact on the findings. The above-mentioned shortcomings will be improved in the next step, thereby providing more detailed data support for this research.

In conclusion, compared with the DAA group, the OCM group had shorter operative time, faster recovery and lower postoperative pain scores, but the difference in hip function between the patients receiving these two procedures was not significant in the long term.

## Disclosure of conflict of interest

None.

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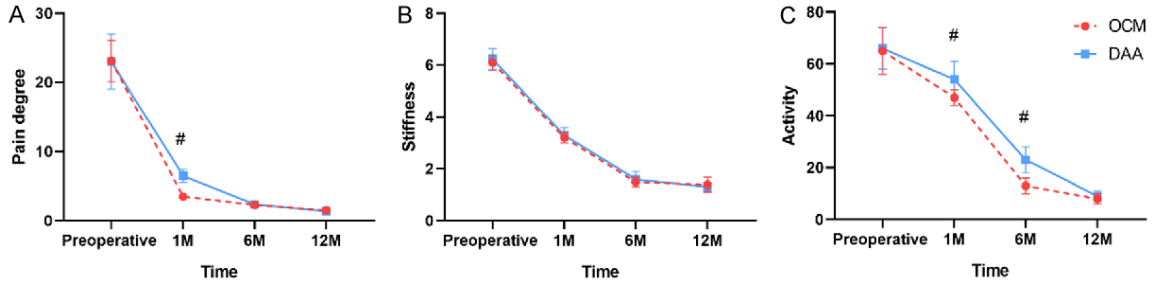


**Figure 6.** Comparison of preoperative and postoperative WOMAC scale scores. A: Pain scores; B: Stiffness scores; C: Activity scores. #$P$<0.05 compared with DAA group. Variance of analysis was adopted, followed by LSD test.

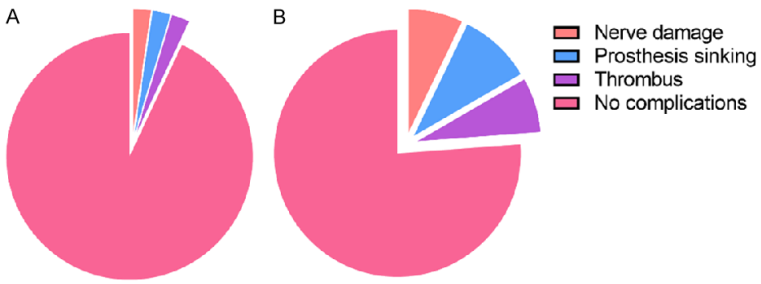


**Figure 7.** Comparison of the incidence of adverse reactions. A: OCM group; B: DAA group. Chi-square test was adopted.

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