Abdominal Obesity Affects Short-Term After Total Hip Arthroplasty: A Retrospective Study

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Research Article

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Abstract

Background: At present, there are many clinical studies on the impact of obesity on postoperative function following total hip arthroplasty, but their conclusions are different and even contradictory. As abdominal obesity (AO), which is closely related to obesity, we know very little about its impact on postoperative function following total hip arthroplasty.

Methods: Sixty-four patients were included in this prospective randomized controlled trial. Divided them into AO group (WC ≥ 90 cm for men and ≥ 85 cm for women) and non-AO group (WC ≤ 90 cm for men and ≤ 85 cm for women). Preoperative assessment included numerical pain rating, the Oxford Hip Score, 6-minute walk test and repeated at 6,12 months postoperatively. Postoperative assessment included the anteversion and inclination of the acetabular prosthesis, satisfaction at 12 months.

Results: The hip joint function of both groups has been significantly improved at 1 year postoperatively. No significant differences were found in hip pain or function between the AO and non-AO groups. However, AO patients had poorer walking capacity (p=0.001).

Conclusion: AO does not increase the complications after THA, nor does it have a significant impact on the function after THA, but it seems to have a negative effect on the improvement of walking ability.

Introduction

In the past 50 years or so, the prevalence of obesity has increased worldwide, reaching epidemic levels[1]. Obesity is an influencing factor that has been discussed in total hip arthroplasty. However, there has been a controversy over whether obesity has impacts on total hip arthroplasty. We reviewed many literatures on the effects of obesity on total hip arthroplasty, their conclusions are not uniform or even contradictory, and they hold opposite views[2-7].

Based on this, we put forward a hypothesis, is there a factor closely related to obesity but not exactly the same that causes the contradiction in the above studies? Abdominal obesity (AO) accounts for more of obese patients, but it can also occur in people with normal body mass index (BMI)[8]. AO's prevalence is increasing worldwide, is a close factor of metabolic syndrome and cardiovascular disease, and increases the risk of hip fractures[9-11]. So increasing numbers of total hip arthroplasties are being performed on AO patients clinically.

Currently, there are several approaches to the total hip arthroplasty including the posterior approach (Moore or Southern), the lateral approach (Hardinge), the anterolateral approach (Watson Jones), and the direct anterior approach (SmithPeterson)[12]. Thereinto, direct anterior approach (DAA) has been improved to have multiple possible benefits, including reduced pain, early gait improvement, early stop walking assistance, low risk of dislocation, faster recovery, and shorter hospital stay[12-22]. Because of the above advantages, anterior total hip arthroplasty is chosen by more and more orthopedic surgeons[12].

As far as we know, AO is still a neglected factor in total hip arthroplasty. There is no research on AO and total hip arthroplasty. In order to explore the impact of abdominal direct obesity on anterior total hip arthroplasty, we conducted this prospective experiment.

Methods

Study design and population setting

The study design was a Retrospective study. The study was approval from the ethics committee of our university hospital was obtained (No.2019-K-306-1). All the cases were from January 2016 to June 2019, with direct anterior total hip arthroplasty under the assistance of DAA stents. All of the patients were informed about the study and gave their written consent. Inclusion criteria: In line with the diagnostic criteria of "Guidelines for the diagnosis and treatment of adult femoral head necrosis 2019". Exclusion criteria: Patients with Parkinson's and other related neurological diseases that affect limb function activities, malignant tumors, stroke, other operations before or within two years after DAA, scoliosis, pelvic anterior tilt, or incomplete data. All operations were performed by an orthopedic surgeon and his team, this orthopedic surgeon has more than 500 THA operations experience. Preoperatively, the patients' waist circumferences (WC) will be measured by a special training doctor. Pre-AO was defined as WC of 85-89.9 cm for men and 80-84.9 cm for women while AO was defined as WC ≥ 90 cm for men and ≥ 85 cm for women[23]. Among them, there is no consensus on the best anatomical position for measuring the abdominal circumference: WHO recommends the midpoint between the last palpable rib and the iliac crest, while the National Institutes of Health recommends it at the height of the navel[10]. This study adopted the recommendations of the WHO. Two groups were formed for the AO. Non-AO group (WC ≤ 90 cm for men and ≤ 85 cm for women) and AO group (WC ≥ 90 cm for men and ≥ 85 cm for women). Follow-up was for 2 years (mean and standard deviation,18±1.3months) ,with a minimum follow-up of 1 year and 2 months and a maximum follow-up of 3 years and 3 months. this study uses first year follow-up data.

Outcomes

The main outcome of this study was the hip joint function, measured using the reliable and validated Oxford hip score (OHS)[24], the anteversion and inclination of the acetabular prosthesis (both the forward tilt angle and the inclination are measured by X-ray radiography[25]). Secondary results included, a numerical pain rating scale [26](with anchors of 0 being no pain and 10 being severe pain), walking capacity assessed[27](via a 6-minute walk test (6 mwt), and patient satisfaction. Walking assessments were undertaken along a 50-metre corridor, by a Physiotherapist blinded to the purpose of study. Patients were deemed walking aid dependent if they used any walking assistive device most of the time. A 5-point Likert scale measured satisfaction with surgery. Responses 'Very Satisfied' and 'Satisfied' were grouped and reported as a percentage. Preoperative assessment included numerical pain rating, the Oxford Hip Score, 6-minute walk test and repeated at 6,12 months postoperatively. Postoperative assessment included the anteversion and inclination of the acetabular prosthesis, satisfaction at 12 months.

Surgical methods and materials

All of the patients were completed by the same orthopedic surgeon with the assistance of DAA surgical stents. With the assistance of DAA surgical stent, the patients adopt a supine position during the operation, and the patient's abdominal fat is squeezed to the opposite side with tape to prevent it from affecting the surgical field of view and reduce the possibility of infection. The surgical approach is to start at 2cm from the lower and outer sides of the anterior superior iliac spine, and the direct anterior approach is incised in the direction of the fibula head. The incision length is 8±1cm. The operation time for all patients was about 2 hours. All patients received perioperative antibiotic treatment (unified use Cefotiam Hydrochloride for Injection) before and 24 hours after the skin incision. The surgical incisions were sutured intracutaneously, and no drainage tube was placed. Early postoperative exercises are recommended (routine exercises can be performed on the first day after surgery) to prevent the formation of deep vein thrombosis.

statistical analysis

The data was collected by two people who did not know the purpose of the experiment then transferred to a Microsoft Excel spreadsheet. All of the measurements were compared after testing to confirm a normal distribution, using the unpaired t test and chi-square test at a significance level of 0.05(IBM SPSS Statistics version 25).

Results

Patient flow

A total of 132 cases were collected, of which 53 cases did not meet the inclusion criteria and 62 cases were excluded. In order to avoid the influence of different surgical approaches on the experimental results, 6 cases of posterior approach were excluded. Seventy patients were included, 6 of whom were lost to follow-up (from the non-AO), therefore, 64 patients (64 hips) were analyzed. Patient flow is depicted in Figure 1.

Patient Demographics

The study included 43 men and 21 women. The men average age was 59.22±9.11 years (range,46 to 78 years) and women average age 58.69±10.01 years (range,33 to 69 years) in the non-AO group, the men average age was 56.00±9.54(range,33 to 76 years) and women average age was 61.75±9.54 years (range,48 to 74 years) in the AO group (p=0.288, p=0.498). The average duration of surgery was 61±11 minutes in the non-AO group and 63±10 minutes in the AO group(p=0.540). The right hip was operated on 34 times and the left hip on 30 times. The average patient height was 165±10cm in the non-AO group and 168±8cm in the AO group(p=0.732). The average patient weight was 69.2±15.4kg in the non-AO and 73.5±17.1kg in the AO(p=0.452). The average body mass index (BMI) was 25.2±3.1kg/m^2 in the non-AO

group and 26.7±6.9kg/m^2 in the AO group(p=0.132). Demographics prior to surgery were similar, excepting the dependent variable of WC (p0.001). (Table 1)

Comparison of post-operative recovery between the two groups

Inclination was 43.00°±4.01°in the non-AO group and 42.37°±3.53°in the AO group(p=0.502). Anteversion was 23.01°±4.53°in the non-AO group and 21.01°±2.99°in the AO group(p=0.404). (Fig 2) In the non-AO group, the OHS improved from 36.15±3.41(range,28 to 42points) to 12.09±0.29(range,12 to 13points) at 1 year postoperatively. The OHS in the AO group improved from 34.48±3.31(range,29 to 40 points) to 12.48±2.69(range,12 to 27 points) at 1 year postoperatively. There was no difference in the improvement of the OHS between the groups (p = 0.408). No difference between the 2 groups was found in terms of whether to revision or whether to re-admitted. (Fig 3) The numerical pain rating scale in the non-AO group improved from 6.00±1.00(range,4 to 7 points) to 0.16±0.90(range,0 to 5 points) at 1 year postoperatively. The numerical pain rating scale in the AO group improved from 5.76±0.97(range,4 to 7 points) to 0.09±0.29(range,0 to 1 points) at 1 year postoperatively. There was no difference in the improvement of the numerical pain rating scale between the groups (p = 0.927). (Fig3) The 6 mwt in the non-AO group improved from 209.55±20.74m (range,140 to 240m) to 357.55±33.00m (range,223 to 386m) at 1 year postoperatively. The 6 mwt in the AO group improved from 207.79±16.24m (range,186 to 245m) to 333.85±17.36m (range,293 to 369m) at 1 year postoperatively. There was difference in the improvement of the 6 mwt between the groups (p = 0.001). (Fig 5) The average patient satisfaction was 97.42±8.55 in the non-AO group and 97.58±6.63 in the AO group(p=0.935). It seemed that everyone expressed great satisfaction with the operation. (Fig 6)

The only complication that needs to be mentioned was the occurrence of revision in 1 male patient in the non-AO group because of periprosthetic infections. No vascular and/or nerve lesions, or dislocations occurred.

Discussion

There are many clinical studies on the relationship between obesity and DAA-THA, they put forward many different viewpoints[28–35]. However, there is still no unified conclusion on whether obesity have a negative impact on total hip arthroplasty. This is conflicting evidence as to whether, how and to what degree obesity may negatively influence outcomes of the total hip arthroplasty. For a more in-depth discussion, we have provided this idea as to whether there is a factor closely related to obesity but not absolutely consistent that leads to this result. Our prospective study explores the factor of AO to prove it.

Our research identified no significant differences between AO and non-AO patients in terms of their hip pain nor hip function 1 year following their THA, the preoperative scores of the two groups were significantly improved. There was no significant difference between the two groups of acetabular anteversion, inclination and patients' satisfaction. However, there was a significant difference in the improvement of walking ability between the two groups. The improvement of walking ability in non-AO

group was significantly higher than that in AO group. In terms of walking ability, AO has a certain impact on patients after THA. This is the same as Samantha Haebich's conclusion[7] on the impact of obesity on THA in 2019. This seems to corroborate the hypothesis proposed in this article. The relationship between AO index and degree of influence has not been discussed in depth in this study. The patient mentioned in the results who underwent revision surgery due to prosthesis infection was in non-AO group, the cause may be intraoperative infection. There was no significant difference in BMI between the two groups in this study, and the influence of obesity on the experimental results was ruled out.

A study by Purcell in 2016 showed that the infection rate of deep and superficial wounds in obese patients increased during DAA surgery[36]. In this study, there was no significant relationship between the occurrence of infection and AO, which seems to indicate that the increase in the infection rate in obese patients is not related to AO. But it is worth noting that the surgical method used direct anterior approach with a specific surgical auxiliary machine. During the operation, we took some measures on the abdomen of patients with AO to reduce the influence of abdominal fat on the operation and prevent it from affecting the surgical field of vision. This may be the reason why we have fewer complications.

In a large cohort study[37] of 124368 patients undergoing THA, the authors found that in patients undergoing total hip replacement surgery, obesity increased the risk of various complications and correction rate. For overall complications, 1-year revision surgery, and 90-day surgery complications, the risk increases with increasing body mass index (BMI). In a prospective study, Chee et al.[38]compared the matching of 55 consecutive THAs in morbidly obese patients with a set of 55 THAs in non-obese patients. The authors found that the incidence of all types of complications was significantly higher. However, there was no significant difference in the risk of superficial and deep wound infection and dislocation between the two group[38].

In our study, all patients have achieved satisfactory results, and postoperative pain, hip joint function and walking ability have all been greatly improved. This seems to indicate that patients with AO can get a more satisfactory effect after direct anterior total hip replacement, that is, AO is not a contraindication for direct anterior total hip replacement, and especially for patients with pulmonary hypertension, it can reduce their peripheral circulation.

AO was the metabolic syndrome component that was a predictor of exercise performance during the 6-minute walk test[39]. AO had a significant impact on sports performance and physical activity. The blood flow of the calf was significantly reduced, which increased the risk of thrombosis in surgical patients. However, there was no significant statistical difference in the 6wt preoperative baseline data of the two groups in this study. The specific reason is not yet clear. Perhaps the pain of hip and limited movement of lower limbs covered the impact of AO on walking ability. This requires further research. In terms of the 6wt improvement of the two groups, the AO group was significantly lower than the non-AO group, and the two groups of data were statistically significant($p = 0.001$). But it cannot be ruled out that the impact of AO on walking ability would appear after pain of hip and limited movement of lower limbs were removed. No patient with thrombosis was found in this study. The specific reason may be the current general use

of “Low Molecular Weight Heparin Sodium Injection” in THA. The impact of the reduction of peripheral circulation on the recovery of the soft tissues of the lower extremity wounds was not mentioned in this study due to the long follow-up time.

As far as we know, this is the first study to investigate the clinical effects of AO on the clinical outcomes after THA. The surgical method used in this study was a direct anterior approach, and some additional measures were taken during the operation for patients with AO. This is not seen in other studies, which may be the reason why our results conflict with other studies. The follow-up time of this study is about 1 year, which is relatively short compared with other studies. To understand the long-term effects of AO on TKA surgery, longer follow-up is needed. This study only counted the patient's weight and abdominal circumference before surgery, but did not consider the patient's weight and abdominal circumference changes during the follow-up period. Finally, the sample size of this study was insufficient for 64 patients, and the sample size should be expanded to conduct more in-depth studies to confirm our view.

In conclusion, AO does not increase the complications after THA, nor does it have a significant impact on the function after THA, but it seems to have a negative effect on the improvement of walking ability.

Abbreviations

abdominal obesity (AO), direct anterior approach (DAA), waist circumferences (WC), Oxford hip score (OHS), 6-minute walk test (6 mwt), total hip arthroplasty(THA), body mass index (BMI)

Declarations

-Ethics approval and consent to participate: Ethics Committee of the First Affiliated Hospital of Zhejiang University of Traditional Chinese Medicine Opinion Number:2019-K-306-01

-Consent to Publication: The authors declare that they agree to participate.

-Availability of data and materials: Information on the data supporting the results reported in this article can be found in the inpatient department system of Zhejiang Traditional Chinese Medicine Hospital.

-Competing Interests: The authors declare that they have no conflict of interest.

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-Authors' contributions: XW was a major contributor in writing the manuscript, ZY analyzed and interpreted the patient data, YZ and JS counted the patient data, Q-WG made suggestions for the structure of the article, W-FJ guided the whole process of this research.

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Tables

Table 1- Patient Demographics

	AO n=31	non-AO n=33	P value
BMI (kg/m^2)	25.37±3.40	26.64±2.00	0.077
Age (years)	59.00±9.79	57.39±9.71	0.513
Gender (Male)	25	18	0.132
Abdominal circumference (cm) male	104.40±7.83	85.22±3.24	0.001
Abdominal circumference (cm) female	93.00±8.76	57.81±7.86	0.001
Oxford Hip Score (0-48)	36.15±3.41	34.48±3.31	0.052
Pain (0-10)	5.76±0.97	6.00±1.00	0.329
6 Minute Walk Distance (m)	207.79±16.24	209.55±20.74	0.706

Mean (Standard Deviation) unless stated otherwise

Figures

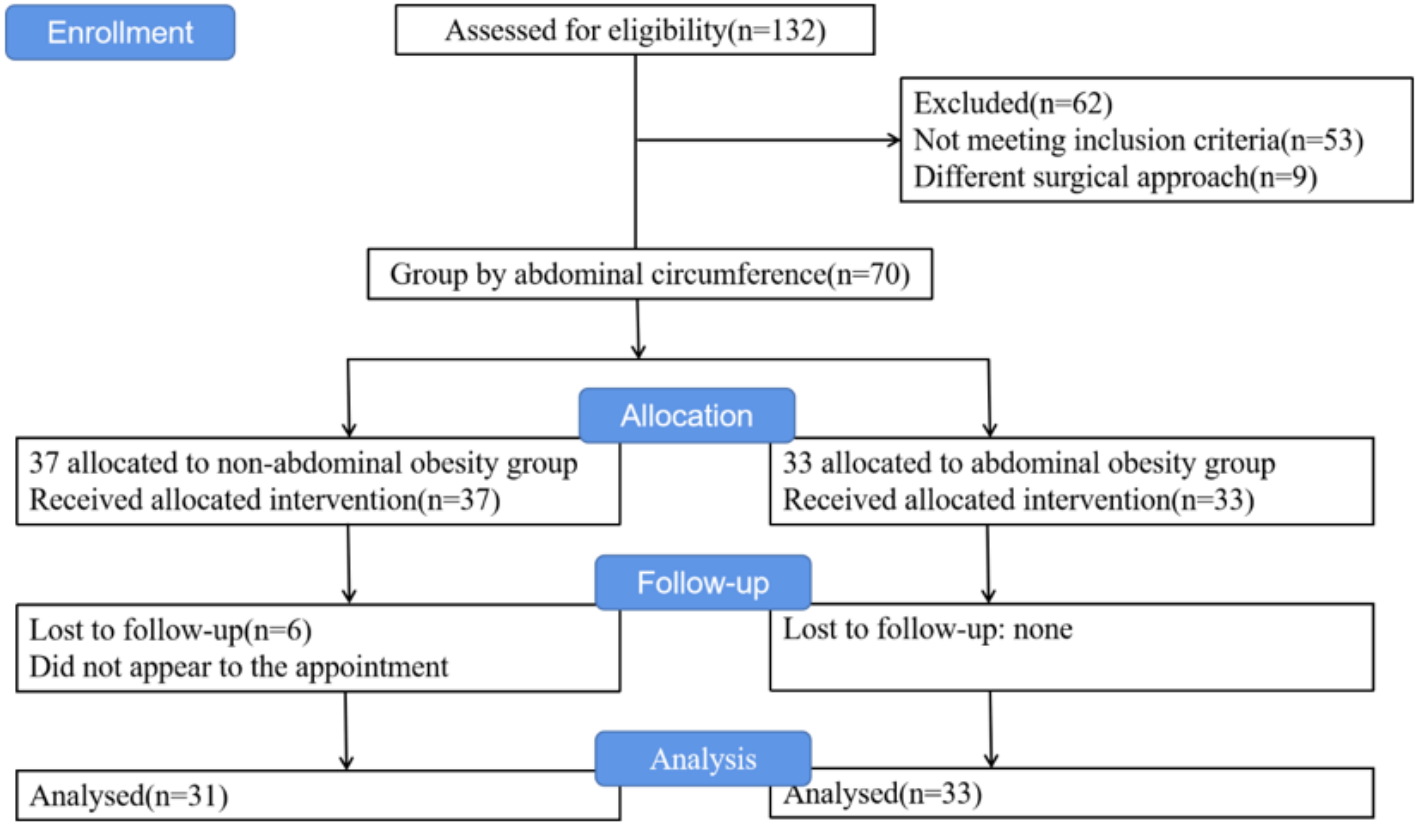

Figure 1

CONSORT (Consolidated Standards of Reporting Trials) flow diagram for the study.

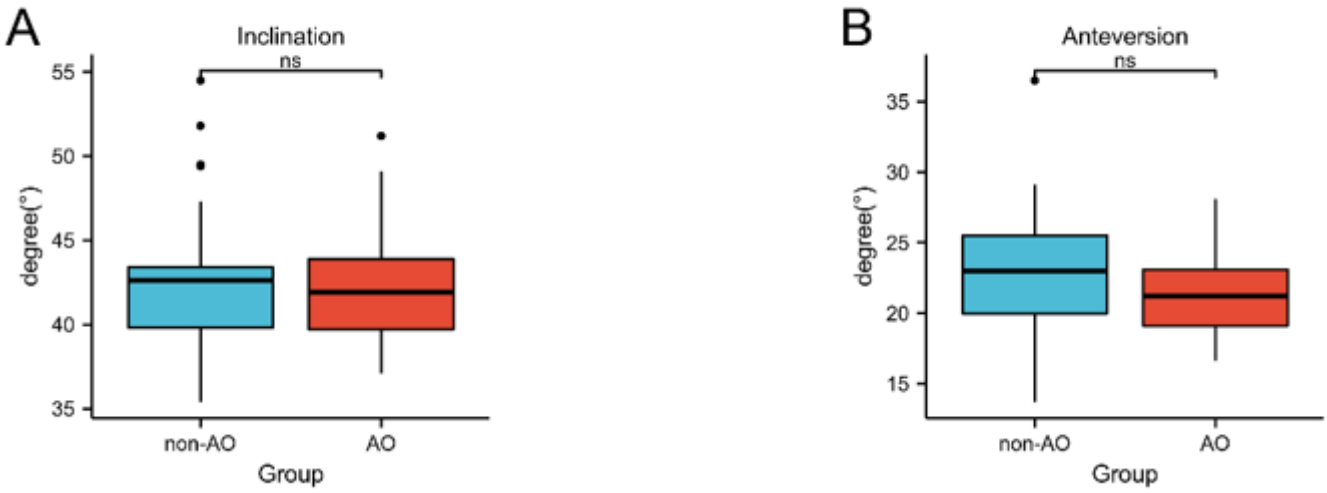

Figure 2

AO and non-AO Inclination and Anteversion. A Comparison of inclination between AO group and non-AO group. B Comparison of anteversion between AO group and non-AO group. NS, no significance.

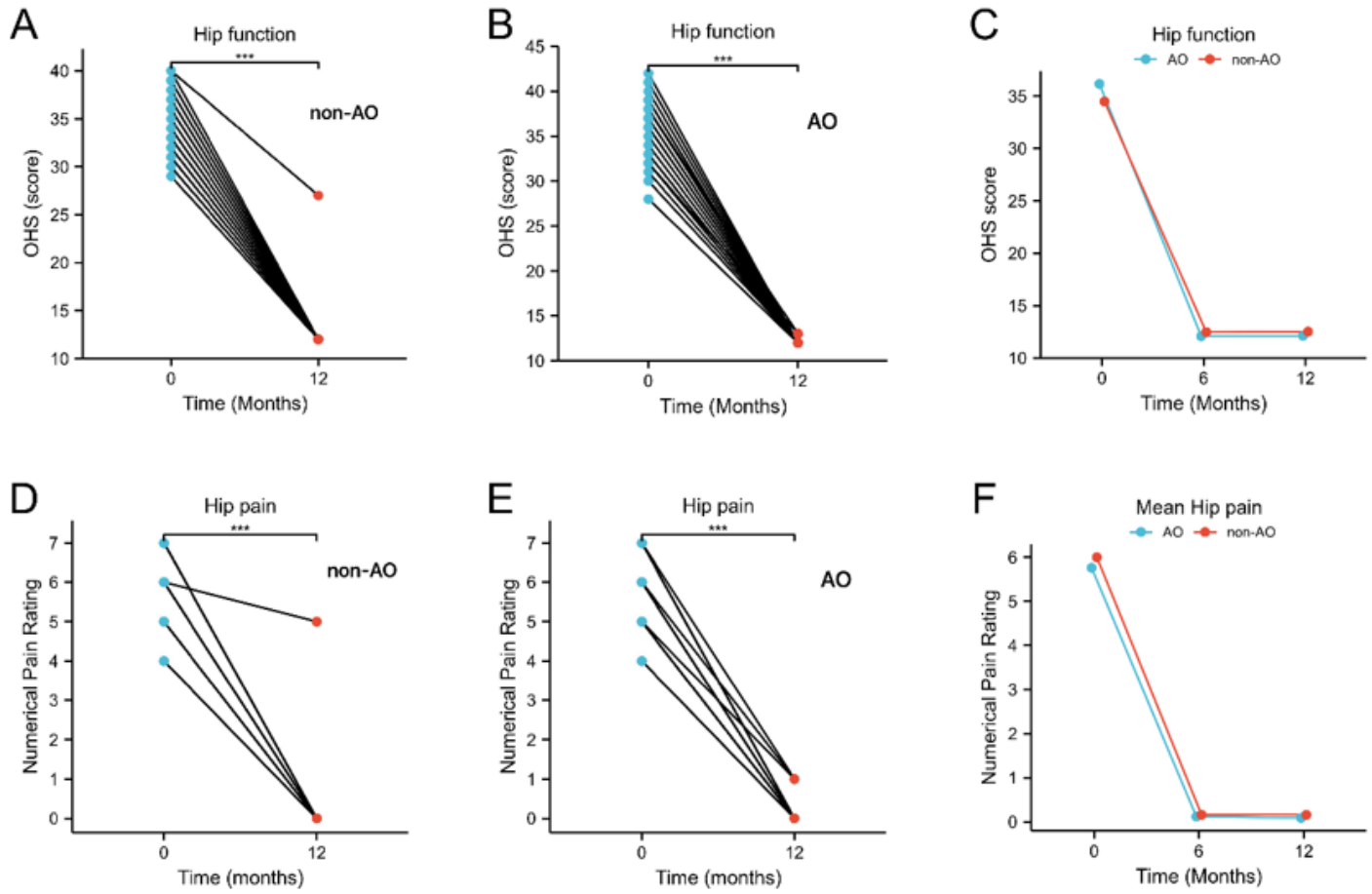

Figure 3

AO and non-AO Oxford Hip Score& Hip Pain. A Comparison of Oxford Hip Score between pre-operation and 1 year after operation in non-AO group. B Comparison of Oxford Hip Score between pre-operation and 1 year after operation in AO group. C Mean Oxford Hip Score of AO group and non-AO group in different periods. D Comparison of hip pain between pre-operation and 1 year after operation in non-AO group. E Comparison of hip pain between pre-operation and 1 year after operation in AO group. F Hip pain of AO group and non-AO group in different periods. ***, $p<0.001$.

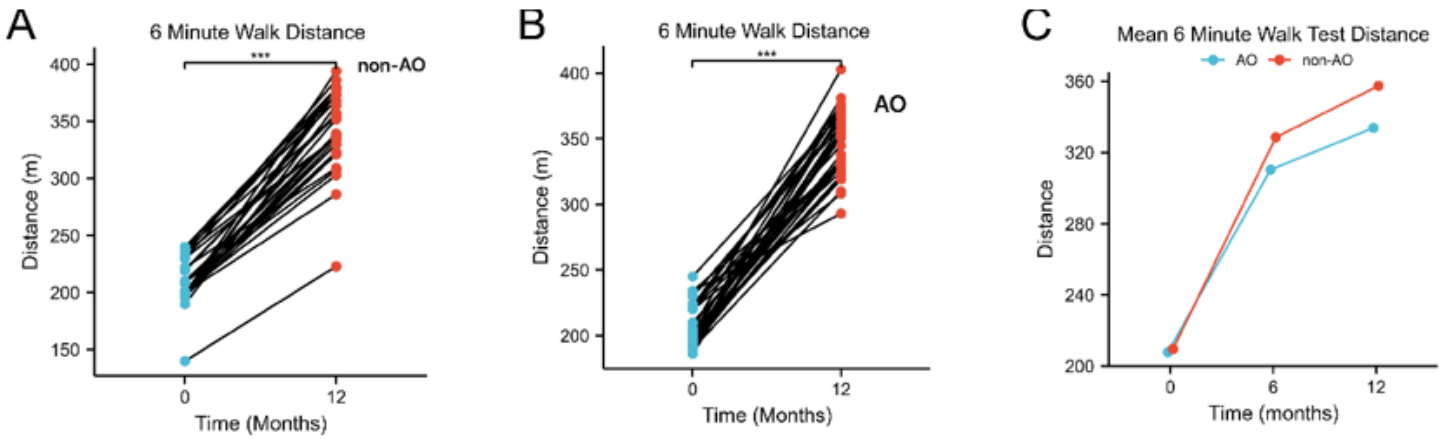

Figure 4

AO and non-AO 6 Minute Walk Test Distance. A Comparison of 6 Minute Walk Distance between pre-operation and 1 year after operation in non-AO group. B Comparison of 6 Minute Walk Distance between pre-operation and 1 year after operation in AO group. C 6 Minute Walk Distance of AO group and non-AO group in different periods. ***, p<0.001.

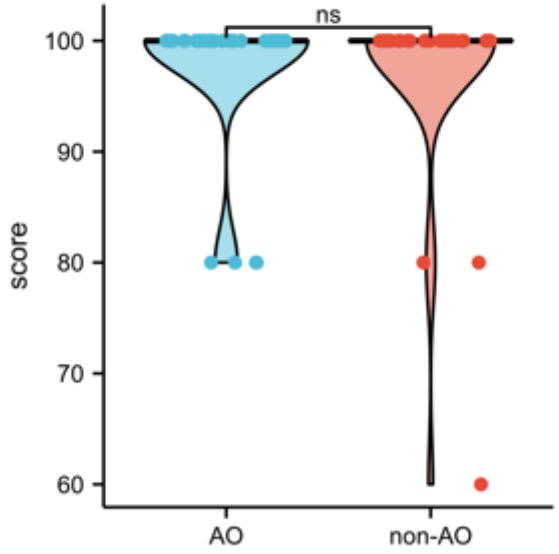

Figure 5

Comparison of Satisfaction between AO group and non-AO group. NS, no significance.