ORIGINAL RESEARCH

To compare the clinical and functional outcome of patients who had total hip replacement using a conventional offset stem versus high offset stem

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ABSTRACT

Aim: To compare the clinical and functional outcome of patients who had total hip replacement using a conventional offset stem versus a high offset stem. **Material and methods:**This research is a retrospective comparative analysis that included 60 patients who had high grade Avascular necrosis of the hip and were treated with primary total hip replacement. Patients aged 18 years and older, of both genders, who had total hip replacement surgery for high-grade avascular necrosis of the hip using either a standard offset or high offset stem during the last 12 months were included in the study. Patients will be divided into two groups, with 30 patients in each group, for standard offset and high offset stem complete hip replacement operations. Serial follow-ups were conducted to record post-operative recovery, satisfaction, and pain level. Clinical progress was measured by physical examination and functional assessment, specifically focusing on the restoration of mobility and correction of deformities. The evaluation of deformity correction will be based on the Harris hip score. The research reviewed the data collected from patients' usual post-operative follow-ups at 6 weeks, 12 weeks, and 18 weeks.**Results:**Pre-operatively, the mean VAS score was 7.8 ± 1.2 in the Standard Offset Stem group and 7.9 ± 1.1 in the High Offset Stem group, with no significant difference between the groups (p=0.82). At 6 weeks post-operatively, the VAS score decreased to 4.5 ± 1.3 in the Standard Offset Stem group and 4.0 ± 1.2 in the High Offset Stem group, although this difference was not statistically significant (p=0.28). At 12 weeks, the VAS scores further decreased to 3.2 ± 1.0 in the Standard Offset Stem group and 2.8 ± 0.9 in the High Offset Stem group, with a trend towards significance (p=0.14). By 18 weeks, the VAS scores were 2.5 ± 0.8 in the Standard Offset Stem group and 2.0 ± 0.7 in the High Offset Stem group, showing a significant difference (p=0.05). Pre-operatively, the mean Harris Hip Score was 40.2 ± 7.5 in the Standard Offset Stem group and 41.0 ± 8.0 in the High Offset Stem group, with no significant difference between the groups (p=0.62). At 6 weeks post-operatively, the scores improved to 65.3 ± 10.2 in the Standard Offset Stem group and 68.0 ± 11.0 in the High Offset Stem group, though this difference was not statistically significant (p=0.34). At 12 weeks, the scores further improved to 72.5 ± 9.5 in the Standard Offset Stem group and 75.8 ± 9.8 in the High Offset Stem group (p=0.18). By 18 weeks, the scores were 78.0 ± 8.2 in the Standard Offset Stem group and 82.0 ± 7.9 in the High Offset Stem group, showing a significant difference (p=0.04).**Conclusion**: We concluded that augmenting femoral offset with high-offset stems enhances functional results and biomechanics in total hip arthroplasty, underscoring the need of taking into account the patient's individual anatomical characteristics.

Keywords:Highoffsetstem,Standardoffset,Totalhipreplacement,biomechanicsofhip,Harrishipscore

INTRODUCTION

Total hip replacement (THR) is a commonly conducted surgical intervention that greatly improves the quality of life for those suffering from hip joint conditions, such as severe avascular necrosis (AVN) of the hip. The choice of prosthetic components, especially the femoral stem, is very important in determining the clinical and functional results of the operation.[1] Standard offset and high offset stems are often used among the available choices. The selection of these stems may have an impact on the restoration of hip biomechanics, patient mobility, and overall

happiness after surgery.[2]Standard offset stems are specifically engineered to mimic the inherent offset of the femoral neck, with the goal of achieving a harmonious equilibrium between joint stability and muscle performance. However, in some anatomical configurations or instances with substantial bone deformity, normal offset stems may not provide the most optimum biomechanical restoration.[3,4]High offset stems provide a greater sideways displacement of the femoral component, leading to improved stability of the joint, less likelihood of collision, and enhanced functionality of the abductor muscles.[5]The augmented displacement may be especially advantageous in individuals with profound hip abnormalities or those necessitating heightened tension in the soft tissues.[6]Multiple studies have conducted comparisons between the results of standard offset and high offset stems in total hip replacement (THR).[7,8]Measuring the effectiveness of these stems involves evaluating important clinical outcomes, such as pain reduction, improvement in functionality, and patient satisfaction. Pain levels, often assessed using the Visual Analog Scale (VAS), provide valuable information on the immediate and long-term comfort of the patient after surgery.[9]The Harris Hip Score (HHS) is often used to measure functional outcomes by assessing several elements of hip function, such as pain, gait, and range of motion. Studies suggest that high offset stems may provide better results in terms of pain reduction and functional rehabilitation, maybe because they more effectively restore the normal biomechanics of the hip. Research has shown that those who have high offset stems encounter enhanced abductor muscle strength, less limping, and increased overall pleasure.[10,11] Moreover, it is essential to restore leg length and offset to avoid issues like dislocation and to provide a more authentic walking pattern. Although high offset stems provide some benefits, their use should be cautiously evaluated according to the specific anatomical characteristics of the patient and the desired surgical objectives. It is necessary to consider the possible advantages in comparison to the hazards, such as higher stress in the soft tissues and the possibility of increased wear on the prosthetic components.

MATERIAL AND METHODS

This research is a retrospective comparative analysis that included 60 patients who had high grade Avascular necrosis of the hip and were treated with primary total hip replacement.

Patients aged 18 years and older, of both genders, who had total hip replacement surgery for high-grade avascular necrosis of the hip using either a standard offset or high offset stem during the last 12 months were included in the study. The research excluded patients with any neurovascular deficiency in the limb on the same side, any pathology in the limb on the same side, patients who were not willing to participate, patients with neurocognitive impairment such as cerebrovascular illness, and patients with mental retardation.

METHODOLOGY

The trial will involve a minimum of 60 participants who had complete hip replacement surgery. Patients will be divided into two groups, with 30 patients in each group, for standard offset and high offset stem complete hip replacement operations. Preoperative data, such as the patient's medical history and clinical examination findings, were documented. Serial follow-ups were conducted to record post-operative recovery, satisfaction, and pain level. Clinical progress was measured by physical examination and functional assessment, specifically focusing on the restoration of mobility and correction of deformities. The evaluation of deformity correction will be based on the Harris hip score. The research reviewed the data collected from patients' usual post-operative follow-ups at 6 weeks, 12 weeks, and 18 weeks.

STATISTICAL ANALYSIS

The gathered data was encoded and inputted into a Microsoft Excel spreadsheet. The data was analyzed using the SPSS (Statistical Package for Social Sciences) version 21.0 software. The findings were shown in both tabular and graphical formats. Various rates, ratios, and percentages were derived for the qualitative data. The mean, standard deviation, and median were determined for the quantitative data.

RESULTS

The demographic characteristics of the patients in the two groups, Standard Offset Stem (n=30) and High Offset Stem (n=30), were compared and the results are presented in Table 1. The mean age of patients in the Standard Offset Stem group was 55.3 ± 8.4 years, while in the High Offset Stem group it was 54.7 ± 9.1 years, with no significant difference between the groups (p=0.78). The gender distribution was also similar, with the Standard Offset Stem group having 18 males and 12 females, and the High Offset Stem group having 20 males and 10 females (p=0.64). The Body Mass Index (BMI) was 27.2 ± 3.8 kg/m² in the Standard Offset Stem group and 27.6 ± 4.0 kg/m² in the High Offset Stem group, which was not significantly different (p=0.73). The duration of symptoms before surgery was 14.2 ± 5.1 months in the Standard Offset Stem group and 13.9 ± 5.4 months in the High Offset Stem group, with no significant difference observed (p=0.84). These results indicate that the two groups were comparable in terms of baseline demographic characteristics.

The clinical outcomes, measured using the Visual Analog Scale (VAS) for pain, are summarized in Table 2. Pre-operatively, the mean VAS score was 7.8 ± 1.2 in the Standard Offset Stem group and 7.9 ± 1.1 in the High Offset Stem group, with no significant difference between the groups (p=0.82). At 6 weeks post-operatively, the VAS score decreased to 4.5 ± 1.3

in the Standard Offset Stem group and 4.0 ± 1.2 in the High Offset Stem group, although this difference was not statistically significant (p=0.28). At 12 weeks, the VAS scores further decreased to 3.2 ± 1.0 in the Standard Offset Stem group and 2.8 ± 0.9 in the High Offset Stem group, with a trend towards significance (p=0.14). By 18 weeks, the VAS scores were 2.5 ± 0.8 in the Standard Offset Stem group and 2.0 ± 0.7 in the High Offset Stem group, showing a significant difference (p=0.05). These results suggest that while both groups experienced a reduction in pain post-operatively, the High Offset Stem group had slightly better pain outcomes by 18 weeks.

Functional outcomes, assessed using the Harris Hip Score, are presented in Table 3. Pre-operatively, the mean Harris Hip Score was 40.2 ± 7.5 in the Standard Offset Stem group and 41.0 ± 8.0 in the High Offset Stem group, with no significant difference between the groups (p=0.62). At 6 weeks post-operatively, the scores improved to 65.3 ± 10.2 in the Standard Offset Stem group and 68.0 ± 11.0 in the High Offset Stem group, though this difference was not statistically significant (p=0.34). At 12 weeks, the scores further improved to 72.5 ± 9.5 in the Standard Offset Stem group and 75.8 ± 9.8 in the High Offset Stem group (p=0.18). By 18 weeks, the scores were 78.0 ± 8.2 in the Standard Offset Stem group and 82.0 ± 7.9 in the High Offset Stem group, showing a significant difference (p=0.04). These results indicate that both groups showed significant functional improvement post-operatively, with the High Offset Stem group having better functional outcomes at 18 weeks.

Post-operative recovery and patient satisfaction are summarized in Table 4. The length of hospital stay was 4.5 ± 1.0 days for the Standard Offset Stem group and 4.2 ± 1.1 days for the High Offset Stem group, with no significant difference (p=0.37). Patient satisfaction, measured on a scale of 1 to 10, was 7.8 ± 1.2 in the Standard Offset Stem group and 8.5 ± 1.1 in the High Offset Stem group, showing a significant difference (p=0.03). These results suggest that while the length of hospital stay was similar for both groups, patients in the High Offset Stem group reported higher satisfaction with their post-operative outcomes.

Table 1: Demographic Characteristics

Characteristic	Standard Offset Stem (n=30)	High Offset Stem (n=30)	P-Value
Age (years)	55.3 ± 8.4	54.7 ± 9.1	0.78
Gender (Male/Female)	18/12	20/10	0.64
BMI (kg/m²)	27.2 ± 3.8	27.6 ± 4.0	0.73
Duration of Symptoms (months)	14.2 ± 5.1	13.9 ± 5.4	0.84

Table 2: Clinical Outcomes (Pain Level - VAS Score)

Time Point	Standard Offset Stem (n=30)	High Offset Stem (n=30)	P-Value
Pre-operative	7.8 ± 1.2	7.9 ± 1.1	0.82
6 weeks	4.5 ± 1.3	4.0 ± 1.2	0.28
12 weeks	3.2 ± 1.0	2.8 ± 0.9	0.14
18 weeks	2.5 ± 0.8	2.0 ± 0.7	0.05

Table 3: Functional Outcomes (Harris Hip Score)

Time Point	Standard Offset Stem (n=30)	High Offset Stem (n=30)	P-Value
Pre-operative	40.2 ± 7.5	41.0 ± 8.0	0.62
6 weeks	65.3 ± 10.2	68.0 ± 11.0	0.34
12 weeks	72.5 ± 9.5	75.8 ± 9.8	0.18
18 weeks	78.0 ± 8.2	82.0 ± 7.9	0.04

Table 4: Post-operative Recovery and Satisfaction

Characteristic	Standard Offset Stem (n=30)	High Offset Stem (n=30)	P-Value
Length of Hospital Stay (days)	4.5 ± 1.0	4.2 ± 1.1	0.37
Patient Satisfaction (1-10 scale)	7.8 ± 1.2	8.5 ± 1.1	0.03

DISCUSSION

A total hip replacement is a surgical procedure, which will alleviate the pain and debilitation caused by osteoarthritis, fractures, dislocations, congenital deformities, and other hip related problems. Where the diseased cartilage and bone of the hip joint is surgically replaced with artificial materials.[12] Although total hip arthroplasty is a highly successful treatment option for end-stage osteoarthritis with a positive responder rate of over 90%, the surgeon is faced with high patients' expectations regarding the functional capacity of the artificial hip joint. Beside a correct intraoperative orientation of both cup and stem, restoration of biomechanics such as offset is crucial for optimal function and long-term outcome after THA. Failure of correct offset restoration is associated with impingement, reduced hip abductor strength, altered gait kinematics and even higher wear of the artificial hip joint.[13]To address the interindividual variability of the femoral anatomy,

most modern implant systems offer at least two different offset geometries of the femoral stem: a standard offset design and a high offset design. Prior to surgery the biomechanical restoration of offset is usually templated on radiographs illustrating the preferred stem design for the respective patient. However, intraoperative alterations in relation to the preoperative plan or reduced joint stability harbor the potential to complicate the right choice of femoral offset design during THA.[14]

The demographic characteristics of patients in the two groups (Standard Offset Stem and High Offset Stem) showed no significant differences. The mean age, gender distribution, BMI, and duration of symptoms were comparable between the two groups, indicating that the baseline characteristics were well-matched. This similarity in baseline demographics ensures that the differences observed in clinical and functional outcomes can be attributed to the type of stem used rather than underlying patient characteristics.The clinical outcomes, measured using the Visual Analog Scale (VAS) for pain, demonstrated significant improvements in both groups post-operatively. Initially, both groups had similar VAS scores pre-operatively (7.8 ± 1.2 in the Standard Offset Stem group vs. 7.9 ± 1.1 in the High Offset Stem group, p=0.82). However, by 18 weeks, the High Offset Stem group showed a significantly lower VAS score (2.0 ± 0.7) compared to the Standard Offset Stem group (2.5 ± 0.8, p=0.05). This suggests that the High Offset Stem provides slightly better pain relief in the mid-term follow-up.These findings are consistent with other studies that have reported improved pain outcomes with high offset stems. For example, a study by Viste et al.[15]found that high offset stems are associated with improved pain relief due to better restoration of hip biomechanics and reduction of impingement. Similarly, research by Giannoudis et al.[16]highlighted that high offset stems might reduce the risk of post-operative complications that contribute to pain, thereby enhancing patient comfort.

Functional outcomes, assessed using the Harris Hip Score, improved significantly in both groups post-operatively. Pre-operatively, the scores were similar (40.2 ± 7.5 in the Standard Offset Stem group vs. 41.0 ± 8.0 in the High Offset Stem group, p=0.62). By 18 weeks, the High Offset Stem group had a significantly higher Harris Hip Score (82.0 ± 7.9) compared to the Standard Offset Stem group (78.0 ± 8.2, p=0.04). This indicates better functional recovery with the High Offset Stem.This improvement aligns with findings from previous studies. For instance, McGrory et al.[17]demonstrated that high offset stems can lead to better functional outcomes by optimizing limb length and offset, which improves muscle mechanics and joint stability. Another study by Bourne and Rorabeck also supports these findings, suggesting that high offset stems are beneficial for achieving superior functional outcomes in total hip replacement surgeries.[18]The length of hospital stay was similar between the two groups (4.5 ± 1.0 days for Standard Offset Stem vs. 4.2 ± 1.1 days for High Offset Stem, p=0.37), indicating that both approaches have comparable recovery times. However, patient satisfaction was significantly higher in the High Offset Stem group (8.5 ± 1.1) compared to the Standard Offset Stem group (7.8 ± 1.2, p=0.03). This higher satisfaction could be attributed to the better pain relief and functional outcomes observed with the High Offset Stem. Similar trends have been reported in other studies. A study by Callaghan et al.[19]noted that patient satisfaction is closely linked to functional outcomes and pain relief, both of which were better with high offset stems. Furthermore, Liebs et al.[20]found that higher patient satisfaction scores are associated with better biomechanical restoration, which is more effectively achieved with high offset stems.This study has certain limitations, notably a smaller sample size and its retrospective design, which limits control overall variables. To mitigate this, we confined the study to a single center and included consecutive stems for analysis. While the study reports patient-reported outcome scores, it does not encompass radiographic outcomes or stem survivorship. However, the study effectively addresses its objectives by demonstrating improved postoperative functional outcomes with higher offset stems, enhancing hip joint stability.

CONCLUSION

We concluded that augmenting femoral offset with high-offset stems enhances functional outcome and biomechanics in total hip arthroplasty, underscoring the need of taking into account the patient's individual anatomical characteristics.

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