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ASSESSING THE IMPACT OF SURGICAL APPROACHES ON TOTAL HIP REPLACEMENT OUTCOMES: A SYSTEMATIC REVIEW

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ABSTRACT

Total hip replacement is one of the most common and effective orthopedic surgical procedures to reduce pain and improve hip function in patients with severe conditions. This procedure has undergone many advances in the past few decades. However, there is debate among surgeons about which surgical approach is the most optimal to apply. This study aims to systematically assess and compare the outcomes of different surgical approaches in total hip replacement (THR) procedures. The method used in this study was a systematic literature review, in which literature was searched through academic databases such as PubMed, Scopus, and Google Scholar using relevant keywords. The collected data were then analyzed through three stages, namely data reduction, data presentation, and conclusion drawing. The results of this study show that each surgical method for total hip replacement has different advantages and disadvantages. The choice of surgical approach should be tailored to each patient's specific condition. Based on a review of the available literature, the anterior approach is often considered superior to the other approaches. The advantages include less surgical trauma, better postoperative pain reduction and a faster rehabilitation process. The anterior approach is considered safe, reliable and effective, and results in lower pain levels compared to other methods.

KEYWORDS *Surgical Approach, Total Hip Replacement, Outcome, Impact*

INTRODUCTION

Total hip replacement (THR) is one of the most common and successful orthopedic surgical procedures, especially in managing pain and improving function in patients with severe hip conditions, such as osteoarthritis. Osteoarthritis of the hip (OA of the hip) is the most common type of hip joint disease and is often treated with hip replacement surgery, apart from proximal femur fractures (Günther et al., 2021).

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THR is recognized as one of the most successful surgical procedures and has even been called the "surgery of the century." Every year, more than one million THR surgeries are performed worldwide, and this number is expected to double in the coming decade. In the United States alone, the number of these surgeries is expected to increase to 572,000 per year by 2030. Approximately 93% of THR surgeries are performed to address severe osteoarthritis that causes intractable pain and functional limitations (Shan, 2014). For patients who do not respond to conservative therapy, THR is the most recommended and effective treatment today.

Total hip replacement procedures have seen many advances in recent decades, especially in terms of surgical techniques, implant design and understanding of bone biology. In the days of ancient and medieval England, the orthopedic treatments available were very limited, and surgery for arthritis did not yet exist. Patients suffering from degenerative hip disease usually had to rely on canes or crutches to walk, and eventually they became immobilized and had to lie down constantly. There were no significant innovations in the treatment of degenerative hip disease until the modern era (Bota et al., 2021). However, over time, surgeons realized the challenges of reconstructing joints damaged by natural factors, such as obstructing soft tissue, so they began using different implants to replace damaged joint surfaces and replace them completely.

Throughout its development, hip surgery has focused on three main aspects: surgical approach and anatomy, trauma management, and joint replacement. Trauma to the hip that requires surgical management often requires an appropriate surgical approach and implant type, which drives the need for constant research and innovation in this field. One of the key factors affecting the long-term outcome of total hip replacement surgery is the surgical approach chosen (Bota et al., 2021).

Surgical approach refers to the method used by the surgeon to access the hip joint during the surgical procedure (Supra et al., 2023). The various common surgical approaches include direct anterior approach, direct lateral approach, posterior approach, and minimally invasive approach (MIS). Among these approaches, the lateral and posterior approaches are considered traditional methods, while the other six fall under the category of minimally invasive approaches. Currently, there is no consensus regarding the most optimal surgical approach for total hip replacement (THR) (Yan et al., 2023).

The choice of surgical approach can affect a variety of postoperative outcomes, including pain levels, recovery of function, joint stability, risk of dislocation and other complications. However, there is still debate among surgeons regarding the most optimal approach, given differences in patient anatomy, clinical conditions, and individual surgical skills and preferences. Therefore, it is important to conduct a systematic review to evaluate the existing evidence regarding the impact of different surgical approaches on total hip replacement outcomes. This review aimed to systematically assess and compare the outcomes of different surgical techniques in THR. The aim was to identify the surgical approach that provides the best outcomes in terms of recovery, complications and implant longevity. The findings from this review are expected to contribute to improving the quality of care for patients with total hip replacement. In addition, the results of this study may provide practical guidance for orthopaedic surgeons in selecting the surgical approach that best suits the patient's condition, developing more effective

surgical protocols, reducing postoperative complications, and improving the patient's quality of life after surgery.

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RESEARCH METHOD

This study used the systematic review method, which is a research method that involves a series of systematic steps to collect, identify, assess, and interpret evidence from existing research results (Snyder, 2019). In this study, a literature search was conducted through academic databases such as PubMed, Scopus, and Google Scholar, using relevant keywords such as “total hip replacement,” “surgical approach,” “assessing outcomes of surgical approach,” and “impact of total hip replacement.” The inclusion criteria for this study were English-language literature published in the period 2014-2024. Based on these criteria, the flow and results of the studies selected for analysis will be depicted in the following PRISMA diagram:

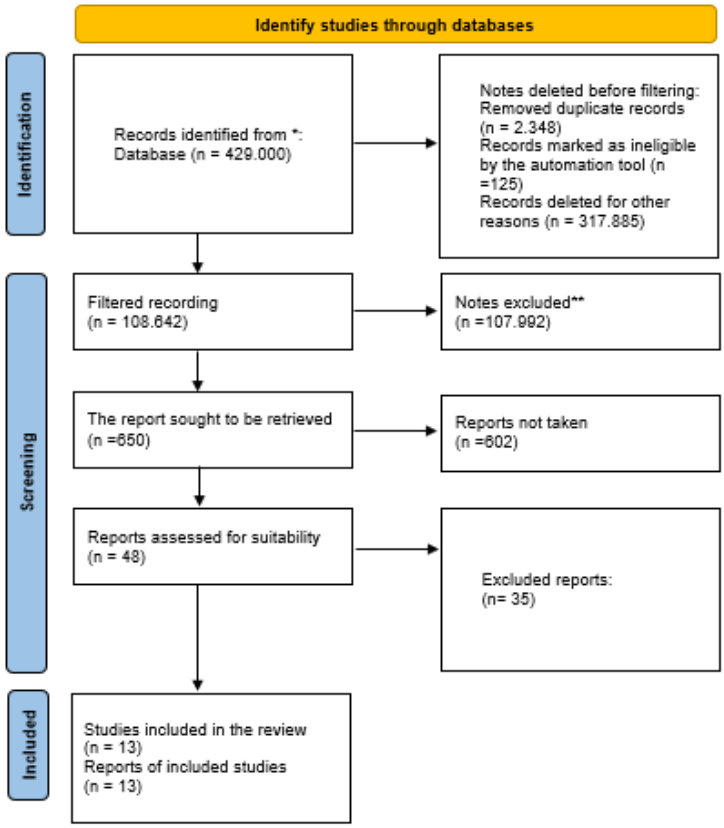

Figure 1. PRISMA diagram

The data that has been collected is then analyzed in three stages, namely data reduction, data presentation and conclusion drawing.

RESULT AND DISCUSSION

After the relevant data selection process, this research involved 13 studies comparing different surgical approaches. The following are the results of the literature study:

Table 1. Research Results

No	Researcher and year Research	Approach surgery on THR	Research Results
1.	Cheng, T. E., Wallis, J. A., Taylor, N. F., Holden, C. T., Marks, P., Smith, C. L., ... & Singh, P. J. (2017).	The direct anterior approach (DAA) and posterior approach (PA) in 72 patients were evaluated before surgery as well as at 2, 6, and 12 weeks after surgery.	Data analysis showed no significant differences between the DAA (n=35) and PA (n=37) groups in key outcome scores, such as the 10-meter walk test, EuroQoL, and radiographic analysis. However, for surgeon 1, the DAA group showed a shorter hospitalization period, lower opiate use, and smaller wounds, despite longer operation time, more blood loss, and less optimal hip flexion at 2 and 6 weeks. Hip flexion activity in the DAA group was also better up to 6 weeks after surgery than the PA group. At week 12, 83% of patients in the DAA group experienced neuropraxia of the lateral cutaneous nerve of the thigh, whereas the PA group did not experience this event. Both groups experienced one dislocation each, and one patient from the DAA group required reoperation due to leg length discrepancy.
2.	De Anta-Díaz, B., Serralta-Gomis, J., Lizaur-Utrilla, A., Benavidez, E., & López-Prats, F. A. (2016).	Direct anterior approach and lateral approach with 49 patients and 50 patients respectively.	This study compared muscle damage and functional outcomes between patients who underwent a direct anterior approach and a lateral approach. Results showed that after surgery, levels of interleukins 6 and 8, as well as tumor necrosis factor-alpha, were significantly higher in the lateral group until the fourth postoperative day. MRI six months after surgery showed that fatty atrophy in the gluteus muscle was more prevalent in the lateral group, although other muscles were similar. The mean thickness of the tensor fasciae latae was significantly lower in the anterior group. Functional outcomes between the two groups were similar at three and 12 months after surgery.
3.	Nistor, D. V., Caterev, S., Bolboacă, S. D., Cosma, D., Lucaciu, D. O. G., & Todor, A. (2017).	Lateral approach (LA) and direct anterior approach (DAA) in 70 patients (35 DAA, 35 LA) with similar demographics, all of whom underwent total hip replacement.	Results showed that postoperative myoglobin levels were significantly higher ($p < 0.001$) in the LA group (326.42 ± 84.91 ng/mL) compared to the DAA group (242.80 ± 71.03 ng/mL), but there were no differences in other biomarkers of muscle damage. Overall pain levels were lower in the DAA group, with both statistically and clinically significant differences on the day of surgery ($p < 0.001$), as well as lower pain medication use ($p < 0.001$) (median 1 (1; 3) mg morphine in the DAA group vs. 3 (2; 4) mg morphine in the LA group). Most patients in the LA group reported chronic postoperative pain for three months, whereas most patients in the DAA group did not report pain after week six. Component placement and complication rates showed no significant differences between the two groups.
4.	Zhao, H. Y., Kang, P. D., Xia, Y. Y., Shi, X. J., Nie, Y., &	Direct anterior approach (DAA) and posterior approach in 120 patients randomized into two groups (n=60 each).	When compared to the posterior approach, the anterior approach had a shorter incision length (9.1 vs 13.1 cm; $P < 0.01$), shorter hospitalization period (2.8 vs 3.3 days; $P = 0.04$), and lower reported pain levels. Serum inflammatory markers and muscle damage were also lower in the anterior group. However, the posterior approach had a

No	Researcher and year Research	Approach surgery on THR	Research Results
	Pei, F. X. (2017).		shorter operative time (65.5 vs 83.3 minutes; P = 0.03) and less intraoperative blood loss (123.8 vs 165.9 mL; P = 0.04). The anterior approach showed significantly lower variance in cup inclination and anteversion. Intraoperative complication rates were similar between the two groups.
5.	Parvizi, J., Restrepo, C., & Maltenfort, M. G. (2016).	The anterior approach and lateral approach were compared in 84 patients.	Both groups of patients showed significant improvement in function, measured by the HHS, LASA, TUG, walking speed test, and LEFS. Functional results at the end of follow-up after one year were similar for both groups. However, at some early time points (preoperatively, at 6 weeks, 6 months, and 1 year postoperatively), anterior patients showed better function than lateral approach patients.
6.	Repantis, T., Bouras, T., & Korovessis, P. (2015).	The minimally invasive surgery (MIS) approach was compared with the conventional approach in a total of 90 adult patients.	The study findings showed lower postoperative pain scores in the minimally invasive (MIS) group. However, no differences were found in terms of perioperative blood loss, functional outcomes, or walking endurance between the groups. In addition, there was no difference in Bicon cup implantation angle measured from postoperative roentgenograms between patients in groups A and B, and no intraoperative trochanter fractures occurred in patients from either group.
7.	Migliorini, F., Biagini, M., Rath, B., Meisen, N., Tingart, M., & Eschweiler, J. (2019).	A minimally invasive surgical approach (MIS) was compared with a standard surgical approach in 4,761 patients.	The results showed that the group undergoing the minimally invasive surgical approach had lower total blood loss, shorter surgical time, and shorter hospital stay. In contrast, the group with the standard surgical approach had higher Harris Hip scores. In terms of radiological outcomes, there was no significant difference between the two methods. There was no difference in the risk of femur fracture, dislocation, or revision rate between the two groups. However, the minimally invasive surgical approach showed an increased risk of iatrogenic nerve palsy.
8.	Hürlimann, M., Schiapparelli, F. F., Rotigliano, N., Testa, E., Amsler, F., & Hirschmann, M. T. (2017).	The minimally invasive approach (MIS), standard transgluteal (STD-Bauer), and modified standard anterolateral (STD-Watson-Jones) approaches were compared in 134 patients.	The STD-Watson-Jones approach showed the highest heterotopic ossification (HO) complication rate. The STD-Watson-Jones group experienced HO in 45.2% of patients (n=19), which was significantly higher compared to the AMIS (23.1% n=9) and STD-Bauer (14.3% n=4) approaches. There was no significant difference between STD-Watson-Jones and MIS-AL approaches (24.0% n=6). Minimally invasive surgical (MIS) approaches generally show lower complication rates. Therefore, if possible, the MIS approach is recommended to be used.
9.	Mjaaland, K. E., Svenningsen, S., Fenstad, A. M., Havelin, L. I., Furnes,	The minimally invasive surgical approach (MIS) was compared with conventional direct posterior and lateral	There were no significant differences in 2- and 5-year survival rates or overall revision rates between the various surgical approaches. The anterior and anterolateral minimally invasive (MIS) approaches as well as the posterior approach showed a lower risk of revision due to infection compared to the direct lateral approach. However, the

No	Researcher and year Research	Approach surgery on THR	Research Results
	O., & Nordsletten, L. (2017).	approaches in 21,860 THA cases.	posterior approach had a higher risk of revision due to dislocation compared to the direct lateral approach. There was no significant difference in the risk of dislocation revision between the anterior and anterolateral MIS approaches compared to the direct lateral approach. In conclusion, the anterior and anterolateral MIS approaches did not show a higher revision rate or revision risk compared to the conventional posterior and direct lateral approaches.
10.	Luo, Z. L., Chen, M., Shang, X. F., Hu, F., Ni, Z., Cheng, P., ... & Zhang, X. Q. (2016).	The direct anterior approach (DAA) and posterior approach were applied to 104 patients, who were randomly divided into two equivalent groups.	There was no significant difference between the direct anterior approach (DAA) and posterior approach (PLA) in terms of operative time, incision length, preoperative Hb concentration, or transfusion rate ($P > 0.05$). However, there were significant differences in intraoperative bleeding, postoperative drainage, and postoperative Hb concentration ($P < 0.05$) between the two groups, with the DAA group showing better results. At one month postoperatively, the DAA group showed better scores than the PLA group in Harris hip score [(83.6 ± 7.1) vs (79.8 ± 6.6), $P < 0.05$], WOMAC [(28.9 ± 6.1) vs (36.1 ± 6.9), $P < 0.001$], and VAS pain score [(2.2 ± 0.9) vs (2.9 ± 1.1), $P < 0.05$]. There were no significant differences between groups in radiographic evaluation and incidence of adverse events ($P > 0.05$).
11.	Amlie, E., Havelin, L. I., Furnes, O., Baste, V., Nordsletten, L., Hovik, O., & Dimmen, S. (2014).	The lateral approach, anterior approach, and posterior approach were applied to 1,476 patients.	The results showed that HOOS scores including pain, other symptoms, activities of daily living (ADLs), exercise/recreation, and quality of life were significantly lower ($p < 0.001$ to $p = 0.03$) in the lateral approach compared to the anterior and posterior approaches, with a mean difference between 3.2 to 5.0. In addition, more patients developed a limp after using the lateral approach compared to the anterior and posterior approaches (25% vs. 12% and 13%, respectively; $p < 0.001$).
12.	Hart, A., Wyles, C. C., Abdel, M. P., Perry, K. I., Pagnano, M. W., & Taunton, M. J. (2019).	The direct anterior approach, lateral approach, and posterior approach were applied to 1,913 patients.	This analysis included 1,967 primary THA surgeries, with 56% using a posterior approach, 29% a lateral approach, and 15% a direct anterior approach. Major complications occurred in 3.9% of surgeries, while minor complications occurred in 9.4%. After considering baseline patient characteristics, no significant difference was found in the rate of major or minor perioperative complications between the three approaches.
13.	Castioni, D., Galasso, O., Iannò, B., Mercurio, M., & Gasparini, G. (2021).	Posterior (PA) and lateral (LA) approaches were applied to 128 patients, with 68 patients undergoing PA and 72 patients undergoing LA.	The study showed that after surgery, CpK levels were higher in the lateral (LA) group compared to the posterior (PA) group (695 ± 648 vs. 447 ± 326 UI/L, $p < 0.001$). At a mean follow-up of 47 ± 22 months for LA and 42 ± 29 months for PA, both groups had significant improvements in IADL, VAS, HHS, and WOMAC scores (all $p < 0.001$). However, the PA group reported better VAS, residual pain, and WOMAC scores compared to the LA

No	Researcher and year Research	Approach surgery on THR	Research Results
			group (p = 0.002, p = 0.004, and p = 0.018, respectively). In addition, the PA group had significantly higher SF-36 mental subscale scores compared to the LA group (49 ± 13 vs. 42 ± 19, p = 0.001). The LA group showed a higher number of Trendelenburg signs (p = 0.029), while the PA group showed higher leg lengthening (p = 0.020), although most cases were less than the clinical significance value of 10 mm (p = 0.738).

Discussion

Total hip replacement (THR) is a type of surgery performed to replace a damaged hip joint with an artificial joint. The aim of this procedure is to relieve pain and improve the ability to move in the hip joint. However, how successful this surgery is is greatly influenced by several things, one of which is the surgical method or approach chosen by the doctor. This method determines how the doctor will perform the surgery by accessing the hip joint to be replaced. The right approach will contribute to the success of the recovery and the final outcome of the surgery.

The choice of surgical methods in total hip replacement (THR) is constantly evolving thanks to advances in technology and research. The main differences between these methods lie in the location of the incision and how the surgeon accesses the hip joint. As described by Petis et al. (2015), some commonly used surgical approaches include:

1. Direct Anterior Approach

This method involves access to the hip joint from the front of the body. The surgeon makes an incision at the front of the hip and slides the muscles and soft tissues laterally to reach the joint.

2. Direct Lateral Approach

This approach accesses the hip joint from the side of the body. An incision is made on the side of the hip and the side muscles are separated to reach the joint.

3. Posterior Approach

This method involves access to the hip joint from the back of the body. The surgeon makes an incision at the back of the hip and moves the gluteal muscles to reach the joint.

4. Minimally Invasive Approach

This approach involves surgical techniques using small incisions and specialized equipment to minimize damage to the surrounding tissues. Specific examples of minimally invasive approaches include minimally invasive lateral and minimally invasive anterolateral approaches.

Each surgical method in total hip replacement has advantages and disadvantages that should be considered by the surgeon and patient. According to previous literature reviews on various surgical methods, the Direct Anterior Approach (DAA) is considered to be more soft tissue sparing compared to the posterior approach. Patients undergoing direct anterior are reported to experience faster recovery in terms of function and activity, making it a potentially more favorable method compared to other methods (Supra et al., 2023).

Research (Zhao et al., 2017), showed that the anterior approach offered a functional advantage in early recovery when compared to the Lateral approach. the anterior approach aided faster recovery with more minimal muscle damage, more effective pain relief, and lower variation in cup tilt and anteversion. However, after a 6-month follow-up period, no significant functional difference was found between these two approaches.

Compared to the posterior approach, the study by Luo et al. (2016) showed that patients who underwent THR with an anterior approach when in the lateral decubitus position showed very positive results. The anterior approach has several advantages, including more minimal surgical trauma, reduced pain after surgery, and a faster rehabilitation process. This method was found to be safe, reliable and effective.

In addition, overall pain levels were lower in the group of patients who underwent the anterior approach, with both statistically and clinically significant differences on the day of surgery. Pain medication use was also lower in this group, with a median of 1 mg of morphine in the anterior approach group compared to 3 mg of morphine in the lateral group. Most patients in the lateral group had chronic postoperative pain for three months, whereas most patients in the anterior approach group had no pain after week six (Nistor et al., 2017).

Data from 12 trials with a total of 4901 replacement procedures showed that the anterior approach was associated with a significantly shorter hospitalization period compared to the lateral approach. In addition, the anterior approach offers better functional rehabilitation and less postoperative pain during the initial period after surgery. However, this approach is also associated with a longer operating time. Both approaches showed similar perioperative surgical complication and transfusion rates and equivalent radiographic analysis results (Yue et al., 2015).

Prospective randomized studies have shown that THR with the anterior approach provides better early functional outcomes, measured by validated functional instruments. Patients undergoing the anterior approach also tended to return to work and achieve functional independence sooner compared to patients undergoing the lateral approach, despite both following the same postoperative rehabilitation protocol (Parvizi et al., 2016).

The direct lateral approach (LA) is often considered a hybrid between the anterior and posterior approaches, with the surgical incision placed on the outer side of the hip. Patients undergoing THR with a lateral approach report worse outcomes 1-3 years after surgery compared to patients undergoing anterior or posterolateral approaches. Lameness was reported twice as often in patients with the lateral approach compared to the anterior or posterolateral approach. There was no significant difference in patient-reported outcomes between the posterolateral and anterior approaches (Amlie et al., 2014).

Additionally, a study comparing the lateral to anterior approach showed that postoperative myoglobin levels were significantly higher in the lateral group (326.42 ± 84.91 ng/mL) compared to the anterior group (242.80 ± 71.03 ng/mL), but there was no difference in other biomarkers associated with muscle damage (Nistor et al., 2017).

While the posterior approach (PA) is a surgical technique performed on a patient in the lateral decubitus position, where the pelvis is stabilized with a padded board placed in front of the pubic symphysis and chest, and behind the shoulder

blades. A padded roll is also placed under the opposite chest wall to reduce the risk of brachial plexopathy. The incision starts about 5 cm below the greater trochanter and close to the middle of the femoral diaphysis, then continues downward and curves toward the superior iliac spina. The skin and subcutaneous fat are separated until reaching the fascia lata and Iliotibial Band (ITB). The ITB and fascia lata are separated longitudinally to divide the gluteus maximus. Retractors are used to split the gluteus maximus and facilitate visualization of the piriformis and short external rotators (SER). The SER is then separated from the greater trochanter and reflected backwards to reveal the posterior pelvic capsule more clearly (Supra et al., 2023).

Patients undergoing THR with the posterior approach reported greater improvement in health-related quality of life (HRQoL), with less residual pain, less postoperative muscle damage and fewer Trendelenburg signs compared to patients undergoing the lateral approach (LA) (Castioni et al., 2021).

Furthermore, in the minimally invasive approach (MIS), the current prospective randomized study did not show significant mid-term clinical and functional benefits for patients undergoing THR with a minimally invasive approach compared to a conventional open surgical approach (Repantis et al., 2015). Research suggests that there is no substantial advantage of the minimally invasive approach compared to the standard surgical approach. However, for the minimally invasive approach, less total blood loss, shorter duration of surgery, and shorter hospitalization time were reported (Migliorini et al., 2019).

A lower complication rate was seen with the minimally invasive approach, so it is recommended to be used whenever possible. This study showed that the minimally invasive approach has a general advantage in terms of operative outcome (HO) and side effects (Hürlimann et al., 2017).

So based on the literature, each surgical approach for total hip replacement has its own advantages and disadvantages, and no method is absolutely better than another. The selection of the right surgical approach largely depends on the patient's individual condition. Therefore, it is important to consult an experienced orthopaedic surgeon before undergoing this procedure.

However, considering the impact of the existing literature review, the anterior approach is considered to have better benefits over other approaches. This statement was reinforced by a systematic review conducted in a meta-analysis by Kucukdurmaz et al. (2019) showed that the anterior approach provides better functional outcomes immediately after primary THR without increasing the risk of complications. However, there was no evidence to support that either approach had a long-term advantage beyond six weeks postoperatively. Another systematic study by Wang et al. (2018) also confirmed that, compared to the Posterior approach, the anterior approach was associated with faster recovery of function and lower pain scores. In addition, the anterior approach was also associated with shorter incisions and less blood loss.

CONCLUSION

The review of the study showed that each surgical approach for total hip replacement including Anterior Approach, Lateral Approach, Posterior Approach, and Minimally Invasive Approach has its own advantages and disadvantages. The selection of the most suitable surgical method should be tailored to the patient's individual condition. However, based on a review of existing literature, the anterior

approach is considered to provide better benefits compared to other approaches. Patients undergoing procedures with the anterior approach are reported to experience faster recovery in terms of function and activity. This approach also offers advantages such as less surgical trauma, reduced postoperative pain, and a faster rehabilitation process compared to the lateral approach. The anterior approach is considered safe, reliable and effective, with lower overall pain levels in patients compared to other groups, both statistically and clinically on the day of surgery.

Based on these findings, surgical practitioners and healthcare providers are advised to consider the anterior approach for better early functional benefits. To expand knowledge in this area, it is important to conduct further research to address the existing lack of information. Future research should focus on in-depth comparisons between different surgical approaches to identify the specific advantages and disadvantages of each method. Further studies also need to explore individual factors that may influence the outcome of each surgical approach as well as identify the latest innovations and techniques that may offer additional benefits.

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