



# Direct Anterior Surgery for Total Hip Replacement

## About the Experts



**Mike van Niekerk**  
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Mr Mike van Niekerk was born in South Africa graduating from Stellenbosch Medical School in Cape Town. He then worked in England before completing his orthopaedic training in New Zealand. He is a member of the Royal Australasian College of Surgeons, the NZ Orthopaedic Association and the International Society of Hip Arthroscopy. His main sub-specialty interests involve Arthroscopic and Arthroplasty surgery of the shoulder, hip and knee, as well as pelvic and acetabular trauma.

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Mr Cameron Cooke is an Australian Specialist Lower Limb Orthopaedic Surgeon with an interest in Adult Hip and Knee Replacements, Sports Knee Surgery and Lower Limb Trauma.

Raised in Brisbane, he completed both his medical degree and advanced surgical training in Orthopaedic Surgery in Queensland with advanced sub-speciality training in joint replacement and orthopaedic trauma in Sydney, Vancouver and the UK.

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Total hip replacement is one of the most successful surgical interventions to be developed. However, which surgical approach to use to achieve an optimal result is unclear. This review discusses total hip replacement surgery with a focus on the direct anterior approach.

## Background

Since it was first developed in 1938, prosthetic total hip replacement has become one of the most successful orthopaedic surgical procedures,<sup>1,2</sup> achieving 10-year survival >95% and 25-year prosthesis survival >80%, in addition to reduced pain, increased mobility and physical function, and improved quality of life for patients.<sup>3</sup>

Consistent with international studies,<sup>4,5</sup> NZ hip joint replacement patients have been demonstrated to achieve longer life expectancy than the general population.<sup>6</sup> The longer life expectancy of recipients of total hip replacement is at least partially attributable to the health benefits of increased mobility and activity levels post-surgery.<sup>4,5</sup>

## Osteoarthritis and hip replacement

Conditions that adversely affect the hip joint include osteoarthritis, rheumatoid arthritis, post-traumatic arthritis, and osteonecrosis.<sup>7</sup>

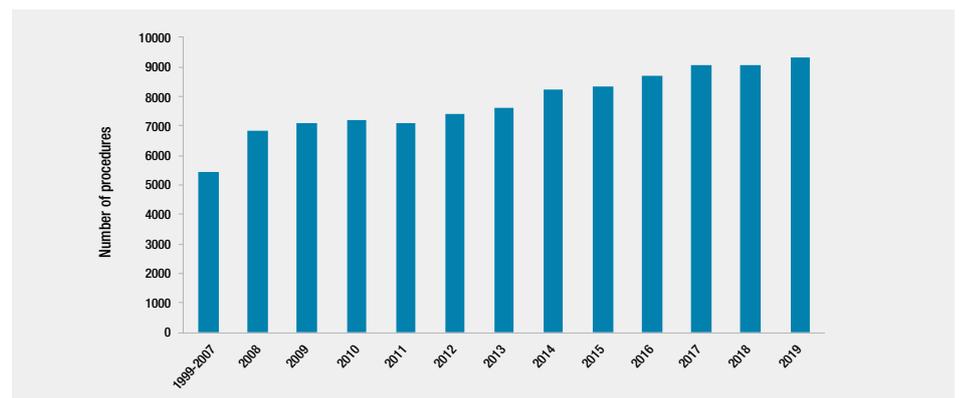
Osteoarthritis of the hip joint is one of the main causes of reduced mobility and is associated with mortality rates that are higher than for the general population.<sup>8</sup> In 2019, 10.2% of New Zealanders were diagnosed with osteoarthritis, which equates to an estimated 404,000 adults.<sup>9</sup>

Consistent with the primary diagnosis in people who receive a hip replacement being osteoarthritis,<sup>2</sup> the New Zealand Joint Registry (NZJR) reported osteoarthritis as the indication for 89% of primary hip replacements performed in 2019.<sup>10</sup>

The survival and general health benefits of total hip replacement translate to the procedure being highly cost effective for the management of patients with hip osteoarthritis.<sup>11,12</sup>

## Prevalence of hip replacement

The frequency of total hip replacement has grown steadily over the last two decades in developed countries, including NZ and Australia.<sup>10,13,14</sup> The number of primary hip replacements performed in NZ has been increasing gradually over the past two decades, from 4,117 procedures in 1999 to 9,449 in 2019 (**Figure 1**).<sup>10</sup>



**Figure 1.** The Number of NZ primary hip replacement surgeries by year for the period Jan 1999 to Dec 2019.<sup>10</sup> Note: the total of 146,787 primary hip procedures registered over the 21-year period includes 2,001 resurfacing arthroplasties.

## Future of hip replacement

The increasing prevalence of obesity and an ageing population will contribute to a greater future burden of osteoarthritis and consequently increased demand for hip joint replacement.<sup>14,15</sup>

The number of total hip replacements performed in NZ has been projected to increase by 84% between 2001 and 2026.<sup>16</sup> A 66% increase in the number of primary hip replacements between 2013 and 2046 is projected for Australia,<sup>17</sup> with the number of procedures due to osteoarthritis projected to increase by 208% between 2013 and 2030.<sup>14</sup>

Greater demand for hip replacements will require appropriate healthcare workforce, resource allocation, and budget planning so that demand can be met.<sup>14,16,17</sup>

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## Surgical approaches to hip replacement

The hip can be accessed via different approaches, including making an incision on the side of the hip (direct lateral or Hardinge and anterolateral or Watson Jones), back of the hip (posterior or Southern), or front of the hip (direct anterior or Smith-Petersen). All three surgical approaches enable safe and clinically-effective hip replacement, with each approach having unique advantages and disadvantages.<sup>18,19</sup>

Given the potential for less invasive surgery to limit soft-tissue injury and result in less post-operative pain and accelerated functional recovery and discharge,<sup>1,20</sup> all three approaches have been refined over time to be used as minimally-invasive forms of hip replacement.<sup>21</sup>

Currently, the posterior and direct lateral approaches are the most used techniques for total hip replacement.<sup>10,20</sup>

Although a recognised surgical technique for most of the 20<sup>th</sup> century, the direct anterior approach has only recently gained popularity.

## Direct anterior approach

The direct anterior approach to the hip joint was first described by German surgeon Carl Hueter in 1881.<sup>18</sup> A Norwegian-born American surgeon, Marius Smith-Petersen, who first performed the anterior approach in 1917, popularised it in the English literature. This approach was mainly used for the washing out of hip infections and treating fractures. In 1947, the Judet brothers in France were the first to perform arthroplasty through this approach,<sup>22</sup> at a time when hip arthroplasty only consisted of a hemi-arthroplasty. They used a fracture table to assist with the procedure but noted that the anterior approach aided in a better functional recovery. The use of a fracture table was re-popularised by American surgeon Joel Matta roughly 20 years ago.<sup>18,23</sup> Subsequent refinement of the anterior approach has led to it becoming a safe, reliable, and feasible technique for total hip replacement.

Greater emphasis on tissue sparing and less invasive total hip replacement in the US during the first two decades of the 21<sup>st</sup> century has increased utilisation of the direct anterior approach.<sup>24,25</sup> Possibly reflecting this trend, the number of NZ hip replacements performed using the direct anterior approach increased from approximately 200 surgeries per year during 2014–2018 to 317 surgeries in 2019.<sup>10</sup>

By taking advantage of the interval between the rectus femoris muscle and the tensor fascia lata muscle, which allows the hip joint to be accessed by moving muscles aside along their natural tissue planes, without detaching any tendons, the direct anterior approach for total hip replacement permits optimal muscle preservation and is the only truly internervous approach to the hip.<sup>18</sup>

The posterior approach requires splitting the gluteus maximus muscle and tenotomy of the external rotators and part of quadratus femoris to approach the hip joint.<sup>18</sup> Splitting of the gluteus maximus muscle cuts through portions of the inferior gluteal nerve, which may lead to partial denervation, with possible weakening of hip extension strength and a decreased ability to perform a squatting motion.

## Learning curve

Surgical approach is one of the many factors that affect the learning curve for total hip replacement.<sup>26</sup> A learning curve is defined as the number of surgical cases required for a surgeon to reach a steady state in complication rate, surgical time, and surgical comfort. As with most minimally-invasive surgical techniques, considerable training and skill is required to achieve optimal outcomes with the direct anterior approach.<sup>27</sup>

Most NZ-trained surgeons will be able to perform the posterior or direct lateral approaches as these are the techniques commonly taught in NZ. Historically, nobody in NZ has performed the direct anterior approach as there has been a lack of training and experience with the direct anterior approach locally until recently.

Due to its recent popularisation and lack of experience with the technique at surgical centres, the direct anterior approach is likely to require a longer learning curve.<sup>24,28</sup> Research has shown that on average it takes 50–100 procedures for a surgeon to progress through the learning curve when changing to the direct anterior approach.<sup>26</sup> It has also shown that this number varies considerably depending on the learning environment, with fellowship-trained surgeons needing a very small number to achieve competence, while those who are self-taught experience a much longer and more difficult path.<sup>29-31</sup> Currently in NZ, there is a limited number of surgeons with the appropriate training and expertise to perform the direct anterior approach safely, but it is on the rise.

## Surgical table type

The direct anterior approach can be performed with the patient supine on an orthopaedic fracture table or conventional operating table.<sup>24,25</sup>

Use of an orthopaedic traction table has been advocated to facilitate access to the femur through an direct anterior approach.<sup>18</sup> This aids delivery of the proximal femur. Some surgeons perform the procedure without a traction table,<sup>18,32</sup> and equally efficacious performance can be achieved using a regular table.<sup>25</sup>

**Mike van Niekerk comment:** Probably the major challenge with the direct anterior approach is exposing the femoral canal sufficiently to allow for safe instrumentation and placement of the femoral component. This has led to development of a number of specialised tables that aim to facilitate external rotation, extension, and adduction of the leg to allow for ease of femoral exposure. Joel Matta developed the Hana table specifically for this reason; however, it is very expensive and out of reach of most NZ institutions. Many implant companies have developed their own tables. However, this ties surgeons to using a specific implant. The specialised table also makes the use of an image intensifier during the procedure easier as the patient is in the supine position. Performing the direct anterior approach without a specialised table is possible but may require more assistance, especially with inexperienced surgeons.

The direct anterior approach is currently mainly performed in the supine position, a position unfamiliar to most hip surgeons as they are primarily trained in the use of the lateral and posterior approaches where the patient is in the lateral position. Changing patient positioning from lateral to supine changes the surgeon's perspective, particularly of the acetabular component and is a learning curve in its own right.

The direct anterior approach can also be performed in the lateral position.<sup>33</sup> This has the advantages of not requiring a specialised table or extra assistance and the perspective of the acetabular component is familiar to surgeons who are used to performing the lateral or posterior approach.

Patients with an increased abdominal adipose tissue are difficult to deal with in the supine position while it tends to “fall away” from the surgeon when patient is positioned laterally. The draping of the patient is also exactly like draping for a posterior or lateral approach, making it familiar to theatre nursing staff who often work with several surgeons.

## Clinical effectiveness of the direct anterior approach

Systematic reviews of early studies comparing the direct anterior approach with the posterior approach found the two approaches to be comparable for long-term outcomes.<sup>34,35</sup> Limitations of these reviews are that both included retrospective studies (hence introducing selection and reporting bias),<sup>34,35</sup> and one review was unable to quantify the primary outcome of pain and function due to the variability of outcome measures utilised.<sup>35</sup>

However, in the first meta-analysis of prospective clinical studies (randomised and non-randomised) comparing shorter-term (<3 months) postoperative outcomes of direct anterior versus posterior approaches in primary total hip replacement, patients treated with the anterior approach reported significantly less pain ( $p < 0.001$ ), consumed fewer opioids ( $p = 0.002$ ), and had better early hip function ( $p < 0.002$ ).<sup>36</sup> One explanation for these findings is that the anterior approach avoids muscle separation and leads to less soft tissue damage while the posterior approach involves detachment of the tensor fascia lata and hence potential for impairment of dynamic stabilisation and limitations on physical activity.

A subsequent meta-analysis that included only prospective randomised studies comparing the direct anterior approach with the posterior approach also demonstrated significantly less pain ( $p \leq 0.005$  up to 72 hours) and better hip function ( $p \leq 0.03$  up to 6 weeks) with the direct anterior approach hence also indicating favourable shorter term post-surgical outcomes with the anterior approach.<sup>37</sup> Additionally, the anterior approach was associated with significantly shorter incision length ( $p = 0.000$ ) and less postoperative blood loss ( $p < 0.041$ ).

Neither meta-analysis of prospective studies found a difference in complications rates (including intraoperative fracture and postoperative dislocation) for the anterior and posterior approaches,<sup>36,37</sup> despite individual studies reporting complication rates for the two approaches having produced conflicting results.<sup>36</sup>

The UK's National Institute for Health and Care Excellence (NICE) has conducted a comprehensive evidence review of randomised controlled trials (RCTs) comparing the



effectiveness of different hip replacement approaches.<sup>28</sup> Acknowledging the limited RCT data that has evaluated the less commonly used approaches for primary hip replacement, NICE proposed that a posterior or lateral surgical approach be considered due to these techniques being established approaches and the evidence not showing a benefit of one over the other.

NICE also stated that, of the various approaches, the direct anterior approach appears better in the short term (within 6 weeks after surgery),<sup>28</sup> which is consistent with the two meta-analyses of prospective studies that identified more favourable shorter-term outcomes with the direct anterior approach than with the posterior approach.<sup>36,37</sup> Although these benefits tend to equalise for longer-term outcomes, returning home the day after surgery, feeling comfortable, and getting back to work and activities of daily living quickly are important factors for many patients.<sup>28</sup>

## Neuropraxia

Neuropraxia of the lateral femoral cutaneous nerve has been reported after the direct anterior approach,<sup>38,39</sup> and the NICE evidence review suggests that the direct anterior approach may be associated with more neuropraxia at 12 weeks than the other approaches.<sup>28</sup> However, symptoms do improve over time and generally do not lead to functional limitations.<sup>38,39</sup>

## Cost considerations with the direct anterior approach

An ageing population and economic constraints in healthcare services are driving the need for cost-effective total hip replacement.<sup>1</sup>

In terms of implant and closure costs, the NICE evidence review found that these were roughly similar for the direct anterior and other approaches.<sup>28</sup> It did note though that additional resource use may be associated with training surgeons to use the direct anterior approach and for treating possible post-procedure neuropraxia.

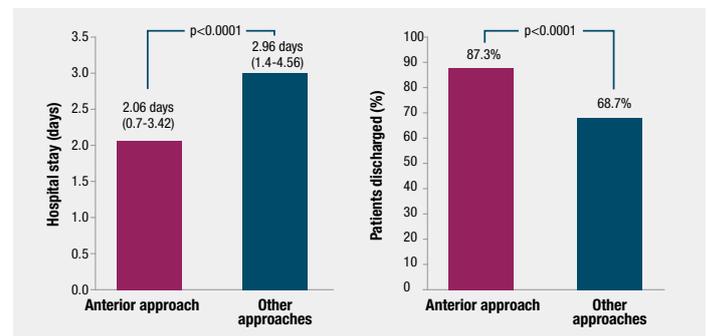
In terms of overall hospital costs, two Canadian analyses have demonstrated that the direct anterior approach is cost saving compared with the posterior and lateral approaches.<sup>40,41</sup> Shorter duration of hospital stay when total hip replacement was

performed through an direct anterior approach was a major contributor to an overall reduction in costs.

An analysis of medical resource utilization for total hip replacement in the US demonstrated that anterior approach patients had significantly lower post-acute care resource use over 90 days after surgery, including significantly shorter duration of hospital stay and higher proportion of patients discharged to home when compared with patients who underwent other approaches (**Figure 2**).<sup>42</sup>

Lower post-acute care costs were also a major driver of lower 90-day postoperative healthcare costs with the direct anterior approach versus other approaches in another US cost analysis conducted from the payer perspective.<sup>43</sup>

The direct anterior approach being medical cost saving post-surgery relative to other approaches is consistent with rapid post-procedure patient recovery with the anterior approach to hip replacement when compared with more traditional approaches demonstrated in RCTs (see **Clinical effectiveness** section). When it comes to patient satisfaction after total hip replacement, the ability to recover quickly after surgery is highly valued.<sup>20</sup>



**Figure 2.** Reduced duration of hospital stay and higher proportion of patients discharged within 96 days of hip replacement surgery through the direct anterior approach versus other surgical approaches.<sup>42</sup>

## MIKE van NIEKERK: NZ CONCLUDING COMMENTS

Hip replacement is known as being the surgical procedure of the century as it provides patients with pain relief and increased quality of life. Despite this success, surgeons continue to strive to refine the technique even more. This has led surgeons to seek ways of lessening tissue damage and achieving a quicker recovery. This is of particular value in working and active individuals.

The direct anterior approach has stood the test of time and is now well recognised as a safe approach, with its popularity growing both internationally and in NZ.

Various techniques of performing the direct anterior approach exist but adopting these come with added initial training and financial costs. These expenses may be difficult to justify given the success of the lateral and posterior approach, in particular with surgeons who have well-established practices. Regardless, I envision the direct anterior approach for hip replacement surgery will continue to grow in popularity among surgeons and provided that they undertake appropriate training there should be no detrimental effects for either surgeon or patient.

## CAMERON COOKE: THE AUSTRALIAN EXPERIENCE

In Australia, the most commonly used surgical approach for total hip replacement is that of the posterior approach. However, increasing numbers of surgeries are being performed through the direct anterior approach.

Since 2015, the Australia and New Zealand Joint Registry has been recording the specific approaches utilised for total hip replacement. In this period, it has recorded 42,189 anterior procedures, 29,055 lateral procedures, and 85,955 posterior procedures. The registry shows there is no difference in the overall rate of revision with surgical approach; however, there are differences in the types of revision and reasons for revisions between the approaches.

The registry has found that there is a lower rate of revision for infection for the anterior approach compared with the posterior approach. The anterior approach was also found to have a lower rate of revision for dislocation compared with the posterior approach. There was, however, a higher rate of revision for loosening with the anterior approach and also a higher rate of revision for fracture compared with the posterior approach. One should take into consideration that this data includes a lot of surgeons that are still on their learning curve with respect to the direct anterior approach and it is probable that over time, with more experience, the complications associated with the anterior approach will improve. The high rate of loosening is most likely secondary to the insertion of undersized stems due to lack

of delivery of the femur because of inadequate surgical releases. As experience and expertise improve, it is probable that the outcomes should improve.

In Australia, surgeons are performing the direct anterior approach both with the use of a traction table and with the so-called off-table technique, (i.e., using a regular operating table). The advantage of the use of the traction table is it allows better delivery of the femur. This can be an advantage for surgeons who are early on in their learning curve, for patients that have a high BMI, for patients that have a high body muscle mass, for significant abnormal bony anatomy, and for revision procedures. The disadvantages of the use of the traction table is the large footprint within the operating theatre, the cost of the table, and the need for a table operator. As surgeons become more familiar with the approach it is likely that more off-table procedures will be performed.

One of the biggest advantages of the use of the direct anterior approach is the supine positioning of the patient enabling easy intraoperative fluoroscopy to assess leg length and off set and also cup positioning. In recent times within Australia, surgeons have also had access to navigation assistance (e.g., the Velys Hip Navigation System), which allows non-invasive navigation to give further intraoperative accuracy of implant positioning. These technologies will likely enable further improved surgical outcomes through better component positioning.



## TAKE-HOME MESSAGES

- Demand for hip replacement is high and growing, driven by population ageing and the obesity epidemic.
- The most common surgical techniques for total hip replacement are the posterior and direct lateral approaches. In recent times, the use of the direct anterior approach has been gaining popularity.
- Due to a lack of high-quality RCTs the best approach for total hip replacement has not been established; each approach has advantages and disadvantages.
- Recent data from the Australian and New Zealand Joint Registry shows no difference in overall rates of revision when comparing the different surgical approaches.
- The direct anterior approach can be performed using either an orthopaedic fracture table or conventional operating table.
- In contrast to the posterior and direct lateral approaches, the direct anterior approach does not involve detachment of muscles and tendons from the hip, which may lead to less post-surgical pain and more rapid functional recovery.
- Earlier recovery after hip replacement allows patients to return to work and other daily activities sooner.
- Better early functional recovery and less pain postoperatively has been demonstrated with the direct anterior approach versus the posterior approach.
- The supine positioning of a patient with the direct anterior approach allows the easy use of intra-operative fluoroscopy, which allows optimization of implant positioning thus improving outcomes for patients.
- Post-acute care medical costs have been shown to be lower with the direct anterior approach versus other approaches, driven mainly by shorter duration of hospitalisation stay.
- Choice of surgical approach for total hip replacement should be based on patient factors and surgeon skill and experience.

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