

Single Stage Revision for Infection

Infection adds a large number of difficulties to fixing a joint replacement that has gone wrong. Some patients are not suitable for single stage surgery, and are better treated with two operations six weeks or more apart. Not all surgeons do single stage surgery.

Infection

An infection around a hip replacement can be like having an infected splinter. It is almost impossible to eradicate the infection without removing the foreign material. A traditional viewpoint is that the foreign material is removed at one operation, and some weeks/months later, a second operation undertaken to reimplant a new hip replacement (a so called two stage operation).

A single stage operation does it all in one go. The theory is that a new implant and antibiotic bone cement will restore function faster, although six months of antibiotics by mouth are usually necessary as well.

Single Stage Surgery is Controversial

Most orthopaedic surgeons in Australia usually recommend two stage surgery. Two stage surgery involves at least six weeks between removing the old implant, and inserting the new one. This may be more advisable if the bacteria causing the infection has not been identified, and will be advised if an uncemented implant is required to reconstruct the leg after removing the existing implant.

The long-term results of single stage revision surgery is in the realm of 90% success. This is a similar success rate to two stage uncemented revision at two years.

How is infection proven?

Infection may be suspected because of particular loosening pattern on x-ray, because the history included fevers or rigors, wound discharge either intermittently or continuously, or blood tests suggest a

problem. Infection may be hard to categorically prove or disprove. Placing a needle into the joint (under x-ray or CT control for the hip) and removing some fluid, can allow our microbiologist to identify an organism & identify the most effective antibiotics. The diagnosis can be confirmed at operation, but clearly it is better to plan for infected cases.



Figure 1. A hip immediately after a single stage revision. The polyethylene cup can't be seen except for a wire marker, and the white bone cement between the cup and the pelvis. The stem is also cemented in place with an antibiotic loaded cement. Large drain tubes in and around the joint are just visible.

Who should have one stage?

Single stage revision allows a fast recovery, and shorter hospitalisation. It is not suitable where structural bone deficiencies are present, or where an extended osteotomy is necessary. Some uncemented hip replacements may not be able to be easily removed and may require two stages.

Advantages of single stage

Single stage surgery means full weight bearing is permissible from the first operation. Transfusion requirements are lower, and theoretically this should avoid the immune compromise of blood transfusions. Time in hospital is reduced, and the time to being functional again is reduced from typically 3-6 months to 4-6 weeks.

A 2011 article from the American Journal of Bone and Joint Surgery indicates the one stage revision improves quality of life, and has a lower death rate.(1)

Why is two stage surgery more common?

Most surgeons only use un-cemented components, especially on the pelvic side of the hip replacement. A certain amount of “dead space” exists between the implant and the bone, giving the bacteria a place to hide & multiply in this environment.

The cement option overcomes this dead space by being pressurised into all the little porosities of the bone, and, the cement is laden with antibiotics specific for the case.

There are cases that are not suitable for one stage surgery, and two stage will be recommended under those circumstances. Where a one stage operation has been recommended, there is a theoretical risk that intra-operatively it will be decided to do a two stage procedure with or without a spacer block.

Is a sinus a contra-indication?

In Rout & Wroblewski’s study of 57 cases using a single stage technique without antibiotics in the cement or long term antibiotics afterwards, they noted a 86% success rate(2). Presumably with antibiotics the success would be higher. The sinus means that the pus escapes from the body, rather than continuing to expand an abscess within the body. This makes removing the

implant more difficult. In my experience to date, the presence of a sinus has not affected the result.

Is a gram-negative infection a contraindication?

In Raut and Wroblewski’s study from 1996, fifteen cases had been undertaken. The two failures had no antibiotics in the cement, which is clearly part of the modern treatment plan.(3) In my experience, many gram negative infections can be treated in this one stage manner.

Trochanteric osteotomy

A key part of the plan is removing all existing foreign material. Bone cement can be very difficult to remove, and a better view of it can be obtained by detaching muscles with a sizable fragment of bone. It is an old fashioned, but proven way of doing the surgery. It does add a risk that the wires can break, and the fragment of bone may not heal. The wires can be tender to lay on. If an osteotomy is necessary, you will require crutches for three months.

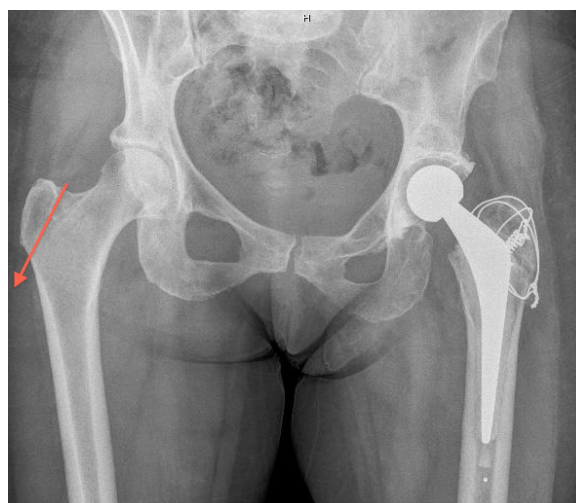


Figure 2. The red line on the left of this image indicates the fragment of bone that would be cut off to allow access to the femoral canal, if that was the side having surgery. The wires (right) are used to reattach the cut fragment of bone at the conclusion.

Who shouldn't have single stage

Smokers can't be cured of bone infection, and should come back when off cigarettes. Uncontrolled diabetic (HbA1c >7.5) should have diabetes improved before surgery.

Ways you can optimise the outcome of surgery

Trying to get rid of an infection is more than just the doctors and surgeons doing their bit!

We don't operate on smokers

It is impossible to clear osteomyelitis (bone infection) in smokers. It is a hard day at the office for surgeon and assistants and a substantial investment in hospital use, if the patients can't be bothered helping us, they're asking too much of us!

Diabetic control is necessary

Long term diabetic control is measured by a blood test HbA1c. Diabetics should know what their HbA1c result is – knowing the number demonstrates insight, being able to tell us it is under 7.5 is better. We measure it on all patients prior to major surgery as plenty of people don't even know they're diabetic until that result comes back.

If HbA1c is too high – we get a physician to see you and modify your diabetic control – for type 2 diabetics – Ozempic has changed our world. It takes too long for HbA1c to come down – we use “fructosamine” as an alternate test – performed through Dorevitch Pathology – a result under 293 means your diabetic control is back on track. Typically that takes one or two months.

The place of “Probiotics”

Surprisingly – the typical human has more bacteria than human cells, most of the are in the intestine. There's an idea that some people have less friendly bacteria in their gut – and we can change this with yoghurt – or even better – daily Probiotic capsules from the chemist. There is some evidence that if there is *Bacillus* species in your gut, there can't be *staphylococcus* – one of our most common infections in joint replacements. *B. subtilis*

Clean Skin

Soap and water daily makes a massive difference, but prior to surgery we provide antiseptic lotions to add to showering the day before and the day of surgery. There are other antiseptic wipes used for the surgical area as you arrive at the admission unit, and

in the anaesthetic bay prior to surgery. In the operating theatre – we use typically alcohol and chlorhexidine antiseptic washes.

If people know they are allergic to chlorhexidine – we usually use iodine in the operating theatre, and more soap, possibly cetrimide for showers beforehand.

MRSA or MRSE in the family?

Normal antibiotics don't cover MRSA – a staphylococcal infection – resistance to “methicillin” means our normal “cephazolin” won't prevent infection from these organisms. For these people we want to “de-staph” them with probiotics, nasal ointments, and different antibiotics.

If we aren't told, we don't know. If you have contact with people recently with infections – please tell us.

Classification of infection

Chierny & Mader classify patients by their underlying health status:

- A: Normal host
- Bs: host with systemic compromise
malnutrition, renal and hepatic failure, diabetes mellitus, chronic hypoxia, neoplasm, and immunodeficiency disease.
- Bl: Host with local compromising factors
chronic lymphedema, venous stasis, major and small vessel disease, arteritis, peripheral neuropathy, and tobacco use
- Bsl: Both systemic & local compromise
- C: Host for whom treatment worse than disease

Pain Management after Major Orthopaedic Surgery

Being comfortable after surgery allows early mobilisation, reduces complications and you go home sooner.

Pain scores

We'd rather the nurses just ask:
"are you comfortable enough?"

Nurses in recovery and the ward will ask you whether you have any pain, and to score it out of ten. It is important that you tell them if the pain is somewhere different than where the operation was. Most patients have a score of close to zero in recovery. If you report 2-3, usually tablets are given, at 5/10 injections of morphine which might cause nausea. Rare to see would be 7/10 with visible signs of pain – teeth clenched, pale appearance, sweaty brow. 10/10 is called "screaming with pain".

Local Infiltration Analgesia

During joint replacement operations, local anaesthetic is infiltrated around the wound by the surgeon. This is mixed with steroidal & non-steroidal anti-inflammatories and adrenaline. The surgeon leaves a wound catheter buried in the bandaging so extra drugs can be injected around the joint replacement the following morning. It has a filter on it to avoid any contamination.

Pain Patch.

Norspan, a narcotic patch, is applied to the skin and gradually releases analgesia. If the patch is too hot, you may become nauseous or drowsy – typically in the shower. Try to keep the patch out of hot water. If your joint is sore you can warm up the patch by giving it a rub, or put on a jumper. The patch typically is changed six days after surgery then stays on 10 days. Some thinner and older patients may not require it.

Background tablets

Mobic (meloxicam) 7.5mg is used twice a day for three weeks. For those that have a history of stomach ulcer, we ask you take an

extra anti-ulcer tablet (eg Nexium/Somac) the night before and morning of surgery. Panadol is used for the first few weeks.

Top up medications

Tramal is my preferred drug to top up. Typically the order is one tablet every three hours as required. Tramal is not perfect, it can cause nausea or hallucinations, and can't be used with many anti-depressants. Usually we have had an opportunity of trying them in hospital before you go home.

Swelling control reduces pain

RICE: Rest / Ice / Compression / Elevation

Rest doesn't mean do nothing, but not do too much. Sitting is NOT good rest as the lower leg becomes swollen.

Ice packs are as soon as possible after the surgery. Be a little careful with areas that have local anaesthetic that you may not be able to feel how cold it is. Do NOT apply ice directly to the skin, and apply it only 20 minutes at a time.

Compression is usually a bulky dressing. Venosan travel socks during the daytime minimise foot and leg swelling.

Elevation. In the first two weeks, put your leg up either on the bed, or lounge suite when you're not moving about. Do not sit for longer than 10 minutes at a time.

Avoiding nausea and vomiting

Our aim is to have you drinking fluid as soon as possible after the surgery, and start eating food by two hours. Avoid orange juice for the first three days as these sweet & acidic drinks can make you nauseous. Gatorade is a sugar & salt drink – this can be used up to two hours before surgery, and when you are alert after surgery.

If you feel sick, tell the nursing staff. It can usually be fixed with anti-nausea medication, but it may be that if you're comfortable and nauseous – that you're over drugged and the pain patch should be removed. It is easier to control it early than to fix it once you start vomiting.

Alternatives to revision surgery.

Infection of a hip replacement may be ignored, treated by antibiotics alone, or the surgery could be to remove all the implants with no intention to replace the hip replacement.

Girdlestone Procedure

Some patients are so ill or the infection so difficult to eradicate, that the prosthesis is removed, with no immediate (or sometimes any) intention of ever reconstructing the joint replacement. Surprisingly, people manage quite well without a hip joint (a so-called Girdlestone procedure). It is hard to imagine resuming a physical job without a hip joint though. In the knee joint, a fusion or stiffening of the joint may be undertaken.

Washout & antibiotics

Washing the joint out and using a six-month period of antibiotics may be considered under certain circumstances. If a joint replacement has been in place for a long time, but suddenly (acutely) becomes infected, it may also be rescued with this plan. If a joint becomes infected immediately after the joint replacement surgery, it is said to be a good plan, but actually does not address any dead space behind the implant. The success rate is in the realm of 50%.

Antibiotics alone.

Sometimes long-term suppressive antibiotics are used, particularly if the risk of surgery seems excessive. It is plausible that no treatment could be undertaken if the patient can tolerate the symptoms, and the situation not predicted to significantly worsen.

No treatment

A low-grade infection might have minimal pain, no discharge, and no disability. A frail nursing home patient is probably better to not treat, even though the infection may contribute to their eventual demise. It is rare to ignore an infection. However, if the treatment options seem worse than the existing symptoms, it is reasonable.

Successes to date with one stage

With staphylococcal infection, once the infection is surgically cleared, the antibiotic in the cement will be effective, but taking oral rifampicin & fusidic acid for a further six months has increased success from 85% using flucloxacillin to close to 100%

Gram negative infections have been cleared. One case, where the surgery was undertaken six weeks after the initial operation, the stem was well fixed, and a sinus existed. The cup was removed, a new cup cemented in place with appropriate antibiotics, and no recurrence has occurred.

Multiple organisms represent a problem in antibiotic choice both for the cement and intravenously. I can only recall one definite case – he had 5 organisms, we used intravenous antibiotics and kept him in hospital for six weeks. At two years, there has been no recurrence of infection.

Failures to date

Failures have occurred in patients who didn't take the antibiotics or use crutches as requested. Osteotomies have failed to unite and dislocations have occurred.

References

1. Wolf CF, Gu NY, Doctor JN, Manner PA, Leopold SS. Comparison of one and two stage revision of total hip arthroplasty complications by infection. JBJS (Am). 2011;93-A(7):631-9.
2. Raut V, Siney P, Wroblewski B. One-stage revision of infected total hip replacements with discharging sinuses. J Bone Joint Surg Br. 1994;76(5):721-4.
3. Raut V, Orth M, Orth M, Siney P, Wroblewski B. One stage revision arthroplasty of the hip for deep gram negative infection. Int Orthop. 1996;20(1):12-4.

Complications following revision surgery for infection

A hip replacement is a major surgical procedure, revision for infection bigger. It carries substantial risks. This list cannot be complete, but does deal with more common problems. Accepting and minimizing these risks is a responsibility of both the patient and the surgeon. If the patient doesn't accept that a joint replacement occasionally goes wrong, then they should not submit themselves to surgery.

Urinary catheterisation. 100%

Urinary catheterisation is routine for major revision operations. It prevents a complication called urinary retention, which is painful and treated by catheterisation. It provides information to the nurses & doctors on your fluid balance. It is usually removed the following morning. Rarely, we can have problems putting the catheter in & may need a urologist (another surgeon) to help.

Thrombosis & pulmonary embolism 1%

Clots can occur within the veins of the leg and pelvis before, during or after surgery. They carry a risk of dislodging and moving up to the lung. It can be fatal. A "post-phlebotic syndrome" where the leg remains swollen can occur, and may develop ulcers.

In first time joint replacements – aspirin, stockings & early mobility is enough to avoid clots. In revision surgery we use Clexane injections, it carries a risk of increased bleeding, swelling, and transfusion requirement.

Recurrence of Infection 5-10%

To minimize the risk of infection, we prepare the operation site with antiseptics, use antiseptic impregnated drapes, use intravenous antibiotics at the time of and after surgery. At St John's we have laminar flow operating theatres and "space-suits".

Removing an infected joint replacement and inserting a "clean one" alone is not enough. The surgery is quite particular & time consuming, antibiotics administered through the cement, intravenously, and by mouth. Despite this, the infection may not be cured and may recur.

Late infection 5%

An infection following revision is more likely a new infection than a recurrence.

You are at particular risk for the first two years following surgery. Any dental extractions, urethral catheterisations, or colonoscopy are usually "covered" with antibiotics. Any cuts to your skin should be taken seriously.

Dislocation 2%

The risk of dislocation is about 2% for traditional hip replacements, and probably for this sort of revision. Most will be for a single dislocation, the others will go on to recurrent dislocations. The most common position patients dislocate their hip is bending right over, sitting, leaning forward, and leaning towards the side of the hip replacement with knee rolled inwards. Less common is with walking and turning abruptly away from the side of the hip replacement. We avoid these for 3 months after surgery.

Dislocations are very distressing. Often an ambulance needs to be called to take you to hospital. A dislocation will upset your confidence.

Leg length discrepancy

The intention after hip replacement surgery is for the leg to match the other one, but stability of the hip joint is more important. If the leg length is right, but the hip keeps popping out requiring an ambulance trip to the hospital, little has been achieved! The leg may seem long for 6-12 weeks after the surgery because the muscles over the side of the hip (glutei) may be tight. As the muscles stretch, the leg returns to a more normal position. Leg length discrepancy is rare with current templating techniques.

Fracture

A fracture of the femoral shaft can occur at the time of surgery, or after injury. It occurs 1:300 primary hip replacements, and probably 1:20 revision operations. The intraoperative cases I have seen have required a cable around the femur and restricted weight bearing. Late post operative cases may require extensive surgery and slow recovery.

Trochanteric osteotomy

This may be required to remove the existing implant safely. This is an old fashioned approach to the hip joint, the author of this (DJM) has used this approach for perhaps 3-400 cases. The complications specific to this are local tenderness contributed to by the wires, It can disappoint us by failing to unite, and some wires are used to reattach the bone at the completion of the operation which will cause limp, and can increase the risk of the hip dislocating.

Death and severe complications

According to the Australia Orthopaedic Association National Joint Replacement Registry - death occurs in 1.6% of patients within 90 days of the surgery and 3.4% of patients in the first year. Age and other risk factors are important in this. The deaths typically occur from heart attacks, strokes, and blood clots. Patient that are medically unstable may be better deferring surgery.

Bowel obstruction

Opioid painkillers such as oxycodone, (Endone), and morphine can slow the gut action, or cause pseudo-obstruction. On occasions the gut gets worse, requires surgery, and possibly a colostomy. We avoid opioids and constipations.

Neurovascular injury

Passing around the hip are nerves and arteries. These supply the leg. Rarely they can be injured, although the cause of nerve injury is only found 50% of the time. Injury to nerves or arteries, permanent loss of function or viability of the limb is possible.

The sciatic nerve is close to the hip joint and prone to injury.

Stiffness

Hip replacement does not guarantee a normal range of movement of the hip. This is typically most obvious when trying to put on a shoe or sock.

Scar pain and numbness

The hip replacement involves cutting a number of layers to do the surgery. It is common for an area below the scar to be numb. The area may become smaller with time (years) but it is usually permanent. More often an area of tenderness over the point of the hip (trochanter) may settle with an injection. These problems have been rare since I changed to minimally invasive surgery. Thigh pain can occur in about 1% of uncemented hip replacements.

Heterotopic ossification

New bone can form around the hip joint after surgery. It may not cause a problem but can cause pain or stiffness. We usually give tablets (eg Mobic or meloxicam) for three weeks to minimize the risk.

Loosening

For a variety of reasons, the fixation between the hip replacement and the bone may fail, this loosening may cause pain and require re-operation. Infection is a cause of loosening, but others exist.

Wear

All hip replacements can wear out. The plastic component is most at risk, but should be able to be replaced fairly easily.

Stroke

A stroke occurs in 0.2% of patients, causing possibly permanent weakness, some deaths.

Other

It is not possible to provide a full list of complications, rare things eventually happen to somebody. If you have a specific question, ask your surgeon, and he will answer it as well as possible.

Financial Consent for Single Stage Revision Replacement

Primary joint replacement might cost \$20,000, but typically the cost of salvaging an infected joint replacement is estimated between \$50 and \$75,000. Most of this cost is born by your insurance company – most of the money goes to the hospital & prosthetics.

Doctors involved in the operation are: the surgeon, anaesthetist, surgical assistant, and if any medical problems occur or are anticipated, a physician. Each will inform you of their fees, the surgical assistant's fee will be explained by BallaratOSM.

Included in the surgeon's fee is performing the surgery, follow-up in the hospital and consulting rooms for three months, to take responsibility for the whole process from selecting and arranging prostheses, and to solve whatever problems occur. Mr Mitchell had additional fellowship training in cemented hip replacements, and learnt the surgical component of single stage surgery there. The antibiotic approach he takes is from St Vincent's hospital infectious diseases department. The surgery takes in the realm of 4-6 hours.

There is no item number for a single stage revision hip replacement, but best approximate is number 49382 which implies a complex revision hip replacement without requiring structural allografts.

The typical fee is \$11285, the same as the AMA suggested fee. As time in hospital and need of any further procedure is not predictable, it is difficult to self fund, and a blow out in cost could easily add \$100,000 if a long time in intensive care and extra surgery is required. The figures provided below are a guess without your specific case in mind, and assume only four days in hospital. The insurance companies pay the hospital typically \$28,000 but typically pay the surgeon only \$865, some from Medicare, the rest comes from you.

ESTIMATES	Insured patients	Medicare but no insurance	No Medicare
Surgeon	\$ 7,815	\$ 8,683	\$ 11,285
Total Out of pocket cost	\$ 12,000	\$ 35,000	\$ 40,000

Included in the package of estimated fees are:

- Hospital, surgeon, assistants, anaesthetist, prosthetic implants, but you will get quotes for each post operative ward rounds, usual blood tests and XRs
- followup phone call(s) after discharge, access to Ballarat OSM nurses for advice
- 2 & 6 week appointment at rooms, and any other visits to the consulting rooms required.
- 12 months follow-up appointment related to the joint

Excluded:

- Physician involvement
- Other orthopaedic or surgical problems

If you are experiencing personal financial hardship, please discuss this well prior to the surgery so an amicable arrangement can be made. The out of pocket expense will be required to be paid two weeks prior to surgery to avoid cancellation.

Patient Consent

True informed consent implies you understand all the risks that could occur. This is hard to achieve. It is possible to regret the decision to have surgery. Attached is a list of complications, with modification from standard hip replacement complications as necessary.

A change to the plan could occur intra-operatively. This would be most likely if:

1. the bone defect can't be reconstructed with cement.
2. The femur needs to be split to remove the existing implant
3. During surgery, you are substantially unwell, and a faster procedure is required

There are cases where a trochanteric osteotomy is required to remove the existing implant safely. This is an old fashioned approach to the hip joint, the author of this (DJM) has used this approach for perhaps 3-400 cases. The complications specific to this are local tenderness contributed to by the wires, It can disappoint us by failing to unite, and some wires are used to reattach the bone at the completion of the operation which will cause limp, and can increase the risk of the hip dislocating.

The antibiotics used can each have specific complications depending on which antibiotic seems best for the organism. This could affect your hearing (rarely), liver (occasionally), appetite, diarrhoea, kidney function, can be permanent requiring dialysis or causing death. The death rate however is lower with single stage surgery than two stage. The antibiotic risk however is not changed by doing two stage surgery. This list of complications is in addition to the normal risk of hip replacement.

Complications of hip replacement attached to this consent include:

Urinary catheterisation, DVT, thromboembolism, pulmonary embolism, death, non clearance of infection, late infection, dislocation, leg length discrepancy, trochanteric osteotomy, infection, bowel obstruction, neurovascular injury including the sciatic nerve, stiffness, scar pain and tenderness, Heterotopic ossification, wear of the hip replacement, and stroke.

Patient Signature:

Date: