Knee replacement is the definitive operation for the treatment of a painful arthritic knee. Essentially, the worn out ends of the bone are replaced with metal and plastic, thus re-creating a functional joint again. During the procedure, any deformity that is present is corrected and, the end result, should be a knee that is well aligned, moves well and causes minimal symptoms. This can be lifestyle restoring surgery.

Types of replacement

There are many types of knee replacement available today, with most designs resembling each other very closely. When this happens, it becomes clear that we have come close to stabilising a design, and that we are not searching for radical changes anymore. It suggests some consensus between all the companies who research and design these products and, as a corollary, it suggests that the current product is quite good and that future improvements will probably be small.

Replacements come either as a total joint replacement, or a partial joint replacement; the latter representing isolated replacement of the medial compartment (most common), the lateral compartment (very unusual), or the patellofemoral joint (uncommon). In recent times, combinations of partial replacements have started to become popularised. Time will tell if this has a future.

Total knee replacement - is the more usual operation, not only because it is more predictable in its outcome and survival, but also because most people have wear in more than one part of the knee: and hence need more than one part of the knee replacing. In this procedure, both ends of the bone are replaced with metal, and a plastic tray is inserted between these both to keep the friction low, and to absorb impact. The kneecap (patella) may also be re-lined with a plastic (or a metal and plastic) button.

Over the years many designs have been tried. It has been found however, that the best designs, are those that recreate the normal knee most precisely. In general, for most joints, the nearer the design approaches the normal, the better the results, both in the short and in the long term. A replacement nowadays is really just a resurfacing of each of the
bone ends. This, unfortunately, does not mean that we can entirely duplicate normal knee anatomy. Indeed, because of some altered ligament function that occurs during insertion of the prosthesis (for instance - the ACL or anterior cruciate ligament is usually lost), it is still not yet possible to totally simulate the normal joint. There are however, newer designs which can duplicate ACL function, or even leave the ACL intact; and these, if proven successful, may subsequently be released to the general market for implantation.

**Hemi-arthroplasty** - (or UKR - Uni-Compartmental Knee replacement) is where only half of the joint is replaced. This is most usually performed where one side of the joint is worn out, either due to injury, or due to earlier removal of the meniscus leading to arthritis (wear) on that side. It is only suitable if the rest of the knee is in very good condition, and if all the ligaments are intact. The advantage of this procedure is that it most nearly re-creates the function of a normal knee. Part of the reason for this is that the anterior cruciate ligament (which generally has to be removed for total knee joint replacement) is left intact. As might be expected therefore, the end result can be very good. It generally produces a knee which has a near normal or very good range of motion, and that range is often achieved reasonably quickly.

This sort of knee replacement is most suitable for the inside half of the knee (the medial side) where it is often referred to as medial compartment resurfacing. Like total knee replacement, there is a replacement of the worn out ends of the bone with metal and plastic bearing surfaces, only here it is only applied to the medial compartment of the knee. The lateral compartment is not replaced, and nor is the patellofemoral compartment (underneath the kneecap). So these areas must be normal, or very near normal.

The big disadvantage of this sort of operation is that the current range of prosthetic devices have a less predictable outcome than do total knee replacements. The Australian National Joint Replacement Registry (ANJRR) shows that survival of these prostheses is considerably less than that of a total replacement, with a significant revision rate (15%) in the first 10 years. It must be said however, that whilst a few revisions occur for failure of the prosthesis, a good number are for pain and on-going problems with the rest of the knee. In particular, for progressive wear in the other parts that have not been replaced.

The above emphasises the importance of restricting this operation to those who really do have wear in only one part of the knee. As such, it should not be considered where there is any wear in other parts of the knee which are either symptomatic, or are likely to become so, after uni-compartmental replacement. This means that, if there is no mechanical reason to explain why there is wear in only one part of the knee (injury, menisectomy, mal-alignment etc.), then it should be assumed that the wear is just maximum in that part of the knee, and that
Overall UKR Revision rate by time

This graph represents the overall failure rate of Unicompartmental Knee Replacement with time, male and female. It therefore, inversely, represents the survival rate with time.

UKR Revision rate by patient age

These graphs demonstrate that the younger, heavier and fitter you are, the sooner the knee wears out or fails. More use = faster wear.

UKR Revision rate by cause

This graph shows the reasons for failure of a Unicompartmental Knee Replacement necessitating a revision in males.

Overall UKR Revision rate by time

The black dotted line shows that the 10 year survival rate for a partial knee replacement is only about 85% at 10 years. The red line shows the result for a total replacement is about 94% at the same time frame.

Premature failure of a partial replacement, be that due to prosthetic failure, progression of disease or pain, can only be treated by revision to a total knee replacement. Whilst this is possible to do, that conversion is not always simple, and the end result may not be as good as if a total knee replacement had been performed in the first place.

The bottom line for hemi-arthroplasty then, is that whilst it provides a very normally functioning knee when it works, the failure rates are not insignificant - being double that of a total knee replacement in the first 10 years. Importantly, only about one person in ten with osteoarthritis of the knee is really suitable for it, which means that it is very important to confirm that all the right indications and criteria are fulfilled. For this reason, experienced, high-volume, knee replacement surgeons tend to use a total replacement for most people (90% or more), using uni-compartmental replacements sparingly. The outcome is then more predictable.

Isolated Patello-Femoral Replacement

Replacement of the patello-femoral joint in isolation is a relatively uncommon procedure. Whilst it has been possible to do this for the last 30 years, the absence of consistently good results has prevented this procedure from becoming popularised. A large review of a retrospective series of patello-femoral replacements was undertaken in a unit in France considered to be one of the best in the world. This showed that if patello-femoral replacement was done, using combined patellar realignment procedures where indicated, then whilst the results were satisfactory, it
turned out that the average result was slightly worse than the average result for total knee replacement.

Isolated patello-femoral replacement is quite technically demanding. The patella itself is relatively easy to replace and getting the component in the correct position is generally possible. The problem however, has been to get the trochlear component (the component that sits in the groove that the patella articulates with) in the right position. It can be lined up with the original trochlear groove reasonably easily, but getting it to meld in with all the surrounding articular surfaces, a difficult three-dimensional problem, is hard.

In the last couple of years, robotic technology has allowed us to position that component much more accurately than ever before. The robot that is used is not strictly a robot in that it does not actually do the surgery, but it has a navigation system that allows the component to be positioned on a 3D model of the knee that has been previously generated by mapping out the landmarks within the knee. This then guides the use of a burr to accurately create a matching defect in the underlying bony trochlear into which the trochlear prosthesis can be cemented. By doing this on-screen, and making all the adjustments on screen prior to bony preparation, this can be done with millimetre accuracy such that there are no protruding lips of metal that can catch on the overlying patella.

With the advent of this newer technology, it is hoped that patello-femoral replacement can be improved to the degree where this can be a regularly recommended procedure. It is to be noted however, that most patello-femoral osteoarthritic problems relate to malalignment of the patello-femoral joint: hence, some sort of realignment may well need to be performed at the same time as the replacement; something that will hopefully produce more normal contact pressures within the prosthetic joint, and lead to less pain and better function.

**Combined medial compartment and patello-femoral joint replacement**

It has always been thought that the knee would function better if both cruciate ligaments, and in particular the anterior cruciate ligament, could be preserved. For this reason, when knee replacement was first conceived, it was thought that individual replacement of the medial compartment with concurrent replacement of the lateral compartment might give results that would be better than a total knee replacement. Unfortunately, the technology of the time was such that this approach was soon abandoned.

With the advent of computer navigation and robotic technology however, this approach is having a renewed surge of interest. Perhaps not so much for the individual replacement of the medial and lateral compartments done concurrently, but for that of
replacing one of those compartments in combination with the patello-femoral joint. Certainly this is now technically possible to do with a high degree of accuracy, and the early results seem to be quite pleasing. Unfortunately however, it will be some years before we know whether or not this early promise is been upheld.

This absence of long term outcome data means that there are limited advocates for such procedures, and it remains to be seen whether these will become part of the standard armamentarium. One factor that may prevent this happening is the recent development of total knee replacements that either preserve both cruciate ligaments, or successfully duplicate the function of those ligaments. Such technology may end up increasing the indications for total knee replacement, thereby decreasing those for combination partial replacement.

The total knee replacements described above (e.g. the Journey 11, and the Journey 11 XR) are currently being implanted overseas. If they prove successful then it will only a matter of time before they will become available, and approved for implantation, in this country. Given that total knee replacement is technically less demanding, and therefore potentially more accurate than partial knee replacement, these newer prostheses may prove to be more reliable, have a lower failure rate, and perhaps equal function to the best combinations of partial replacement. Only time will tell.

Cement or no cement?

Traditionally joint replacements have been cemented into the bone. Theoretically this would seem to be a good idea. It means that the prosthesis is solidly glued into the bone at the outset, and that recovery should therefore be fairly quick. In addition, the cement seals the ends of the bone which cuts down the bleeding. Hence, there is less bruising and swelling after surgery, so motion should return more quickly.

The problem with this approach is that bone is living and, unlike wood, bone it is constantly being removed and replaced. Whether, during this cycle of constant rejuvenation, it grows back as strong as it was depends on a number of factors, including local forces through the bone.

On the tibial side it is usual for a rigid base plate to be used, this being a tray for the polyethylene bearing surface. Independent of how accurate the bone cuts are, and how good the cementation is, the tray will always sit on some slightly high points putting extra pressure on those areas and hence lowering pressure on other areas. This leads to high stress areas where the bone builds up to support the tray and low stress areas where the bone may just be resorbed (osteolysis). Generally, these variations of bone strength, whilst visible on x-ray, are not a great clinical problem. Sometimes however, in high demand patients, the high stress areas can develop stress fractures and stress reactions which can be painful. The opposite effect, where bone that is shielded from stress leads to resorption may, in turn, lead to prosthetic loosening: though this is unusual.

For the above reasons, engineers continue in their quest for a reliable, cement free joint replacement. In most cases, this involves having a special porous surface on the back of the metal prosthesis which allows the bone to grow into it. If this occurs, then the stresses that go through the joint should be much more like normal, and hence, bone may not only not disappear from under the metal, but rather, may even build up and become stronger. Many such surfaces have been developed and all seem to work to a variable degree. Bony ingrowth however, is still not guaranteed: and sometimes, microscopic loosening may occur which can be symptomatic.

Dr Holt currently cements all his prostheses in, having had some failures from uncemented versions. Different prostheses however have different mechanics and different ingrowth surfaces, and hence, some are more suited to being used in their uncemented versions. Accepting all this variation, the literature is still unclear as to whether the long term outlook for a cemented joint is any different from an uncemented one. At this stage therefore, this remains the surgeon's preference depending on his experience with the prosthesis he uses.

Patella or no patella?

Resurfacing of the patella (kneecap) with a polyethylene button is one of the most controversial areas in knee replacement surgery. Most studies in the literature show that, at least in the first 5 years or so, there is no difference in the results whether the patella is replaced or not. In the last few years however, longer term results are starting to show that patella replacement may be advantageous. Kneecap pain is a not infrequent
problem after replacement, whether or not it has been resurfaced. The incidence of this problem may be up to 25% in some designs when un-resurfaced, but in no designs is it completely avoided, even with a polyethylene button on the bearing surface.

Most big surveys of knee replacements are now showing that the ability to be able to climb and descend stairs is enhanced by having the patella resurfaced. Given the low complication rate of patella replacement therefore, it would seem reasonable to carry this out at the time of the initial procedure. Certainly, the advantages of this versus leaving the patella alone, are now becoming more compelling. For this reason, Dr Holt resurfaces every patella with a polyethylene bearing surface (button). This then avoids the problem of having to comeback and resurface it later if there is on-going patella pain. It does not however, guarantee that there will be no patella pain.
Knee Replacement - A Summary

A pre-operative clinic is run by the hospital, and it is important to try and get to that so that your hospital stay will be as smooth as possible. The hospital will contact you, and arrange this with you directly. During that clinic, pre-operative tests (blood tests, ECG etc.) will be carried out, and an orientation will be arranged: so that you are familiar with the procedure and the post operative care.

Drug issues must sorted out in time for your surgery, and some of these will need a week or so to get right. For a general review of what to do, with what medications and when, please look at the information sheet on Dr Holt’s website (Adjusting Your Medications in Preparation for Surgery).

Sleep apnoea & lap bands can both be an issue with surgery. For those with sleep apnoea and for those who have a laparoscopic band in situ, there is information on the website (Lap banding & sleep apnoea info).

Admission and time in hospital: For replacement surgery, health funds now insist on admission into hospital on the day of surgery whenever possible and, for cost reasons, they discourage earlier admission. Because of the DRG (Diagnostic Related Group) system that health funds now use, they will only pay for a certain number of days in hospital for a given procedure. For single knee replacement this is 5 days, and for bilateral replacement, it is 7 days. This means that if you come into hospital a day early, you will have one less day to recover before your fund will stop paying for you.

Average length of stay for knee replacement has been coming down significantly over the last several years. This is particularly so because of the nerve blocks described below, and because of our ability to perform most replacements without the use of a tourniquet (which causes pain in its own right). Currently, those with a single knee replacement are frequently getting home on day three (range 2 to 5), and those with bilateral knee replacements are getting home on day four (range 3 to 7).

Anaesthesia: Our current preference is to use general anaesthesia with adjunctive nerve blocks and local anaesthetic infiltration into the joint. The nerve block of choice is a so-called ‘adductor canal’ block which is performed in the mid to upper thigh. This blocks the saphenous nerve which supplies a good deal of the front of the knee where the wound is. In general, a catheter is left in situ so that local anaesthetic can be infused continuously for 2 to 3 days. It can also be topped up with stronger anaesthetic where necessary. This has proved extremely effective in reducing pain post surgery.

Blood transfusion is rarely necessary in knee replacement, even in bilateral simultaneous knee replacement. If there is chronic anaemia present, then iron stores can be measured and, if low, an iron transfusion can be arranged. This can take a couple of weeks to work but it significantly helps recovery, and significantly decreases the chance of requiring a transfusion.

The routine use of tranexamic acid, both systemically and into the joint to prevent bleeding, has also proved to be a major factor in reducing the need for blood transfusion.
reproduced. Robotic surgery, at this stage, is merely a variation on that, and it uses the same computer navigation system that is employed for non-robotic surgery. Indeed, so-called ‘robotic’ surgery is really a misnomer given that the robots do not in fact do the surgery. Rather, the surgery is done manually, but the planning is done on screen: and the robot helps guide the bone cuts and bone removal for insertion of the prosthesis. At this stage, there seems to be very little, or indeed no advantage, to be gained by using the robot for total knee replacement. On the other hand, it seems to have some advantage in partial knee replacement, particularly for isolated replacement of the patellofemoral joint.

Driving is allowed when you can manage without crutches. This usually happens at about the 6 week mark and, for legal reasons, 6 weeks post surgery seems to be about the right time.

Time off work, on average, is 2 - 3 months, but may be less if the job is relatively sedentary. It is best not to push to get back to work too early, and not to try and be better than average. Rest is a very important element in recovery, and is essential to allow early reduction of swelling. This, in turn, is important to maximise the amount of flexion that the knee can achieve post surgery.

Physiotherapy

Whilst in the hospital there will be on-going physiotherapy to help with recovery. When leaving the hospital, a home exercise program is provided. In some instances, further physiotherapy will be ordered but, for a lot of people, this is not necessary.

Home help etc.

If you think you are going to need home help, or the installation of home aids, the earlier these are organised the better so that it does not delay your discharge. The pre-op clinic is a good place to start this process off, and the staff there can advise if asked.

Rehabilitation

Most big hospitals now have a rehabilitation unit. This is run by the Geriatricians and space is always limited. In order to be considered for a period in the rehabilitation ward, you have to be assessed by those physicians: and the reason for admission into their care has to be medical. This cannot be organised ahead of time, and you cannot be pre-booked into this ward. If it seems necessary to prolong your stay because of medical reasons however, then Dr Holt will have one of the physicians come up to the Orthopaedic ward to assess you.

Please note that not all health funds will support a period in a rehabilitation ward and, even those that do, require a documented medical reason before they will cover such. Living alone, wanting the knee to be better than it is, wanting physiotherapy in hospital rather than at home, are all non-medical reasons - so these won’t get you to the rehabilitation ward. Organising family or a friend to help you after discharge, even if they just check on you by phone, is important. Please look at the information sheet on Dr Holt’s website (Total Knee Replacement - The Journey) for more information on this.

Expectations and results

Pain Relief is, for most people, the single biggest reason to consider replacement: and results of the larger series do indeed show that the vast majority are pain free or have minimal aches and pains in the
longer term. Overall however, it must be said that a knee replacement is not quite as pain free as say a hip replacement, and does not recover as fast. This may be due to the fact that the knee is relatively superficial, and not surrounded by muscle like the hip. It may also be because of the complexity of this joint in comparison to a hip. Either way, the results, at least in the short term (the first year), are probably not quite as good as a hip replacement.

The graphs shown below are derived from pain studies published under the title:

*Knee pain during the first three months after unilateral total knee arthroplasty. A multi-centre prospective observational cohort study.*

Morze, C, Johnson, N, Williams, G, Moroney, M, Lamberton, T, McAuliffe, M.

The concern with knee replacement is the group that have difficulty managing their pain (black line ~10%), and who still have 5 out of 10 ‘best pain’ scores at 3 months. In the first 6 weeks this group are barely better than they are in the first week post surgery. Various strategies for this are now being used, but only time will tell if they are effective.

This group is in complete contradistinction to the group at the other end of the scale who have almost no pain by 6 - 8 weeks (yellow line ~10%). The reasons for this are unknown, and it does not always seem to relate directly to swelling, stiffness or other operative factors, albeit that these may be the cause of some of this problem. One of the indicators for being in either the best or the worst group, is the degree and extent of arthritis that exists pre-operatively. We know for instance, that those people who have tolerated a really bad knee for a long time, will tolerate a knee replacement; and hence are expected to do well. On the other hand, those who come to replacement with significant ongoing pain, and yet do not have a particularly arthritic knee, generally will not do so well. Obviously this has something to do with pain tolerance, but other factors are almost certainly at play as well: and this guide is not always correct. Either way, a lot of work is being done to try and improve the short term figures and make the initial few weeks better.

**The longevity of a knee replacement** is probably the best of any joint that can be replaced. We know from the ANJR (Australian National Joint Replacement Registry) that the prostheses implanted in the early 1990s are surviving for 15 to 20 years before they all need to be revised. The current prostheses, particularly those with a ceramic coating on the femur, in association with highly cross-linked polyethylene on the tibial tray, test out in the laboratory to over 30 years. Of course only time will tell if this is a realistic expectation, but there is every indication that this might prove to be the case.

**Range of motion** is variable and unpredictable, even from a left to a right knee in the same patient. Certainly all knees behave differently, and the results of replacement vary because of many different factors. Suffice it to say that, at one year post surgery, 120° of flexion (bend) is average. Being an average however, means that for every patient who achieves 140°, another will only get 90°. Maximum flexion is rarely achieved under 12 months and improvement may continue for up to 24 months post surgery. To end up with less than 90° of flexion however, is very uncommon but, if this happens, there are things that can be done in the post operative period to help.

It is important to realise that knee motion is restricted by the arthritic process. It is also important to understand that it is difficult to achieve a better range of motion following surgery than existed pre-operatively. Hence, a knee can be left too long before opting for replacement. The corollary is that, if you only have 90° of flexion pre-operatively, it is unlikely that you will reach the average range of 120° post-operatively.

The aim, for the most part, is to get as much motion as possible after surgery because this allows more activities to be possible. As a minimum, 90° of flexion is required to get in and out of a car with some facility, and to sit on a chair comfortably. To ride a bike usually requires 105° to 110° and, to climb stairs, requires a similar range. To climb a ladder may require 120° and, only if more range than that is obtained, can squatting down be contemplated. For most people, the thought of being unable to squat down or kneel is of little concern compared to the benefits of pain relief and mobility,
however, it may be very important in some trades and in those religious groups who have to kneel for prayer.

**Bleeding and bruising** in and around the knee also affects final range of motion. Published results confirm this, and show that, those people who have to take anti-coagulation in the peri-operative period are likely to end up with a stiffer knee, with less resulting motion, than average. For this reason, anti-coagulation has to be modified and carefully controlled in this period.

**Kneeling** is possible following replacement, but most people choose not to do this. It does not harm the joint to kneel but it just doesn’t feel right, even if the range of motion will allow it. It is reported that whilst 85% of people can kneel, only 15% will choose to do so. This means that the serious gardeners will need to find a low stool or chair to use: or perhaps one of the other fancy devices that are made specifically for this purpose.

**Squatting** is also difficult, mostly because of the limitation of knee bend that results from the procedure. Nevertheless, most people who come to replacement cannot squat pre-operatively, so for them this will not be a change.

**Complications and problems**

**Skin numbness** on the outside of the scar is usual after surgery. This is because the small superficial skin nerves that supply that area come from the inside of the leg and are cut during the approach to the knee. Whilst this is initially quite noticeable, over a 1-2 year period some sensation appears to return. Ultimately, this area becomes less numb and, as a consequence, becomes less noticeable.

**Residual pain** is rarely a major problem. Sometimes however, residual aches and pains occur which, despite the passage of 9-12 months, persist and are difficult to explain. Some are due to loosening, some to infection, some to mechanical problems and so on. Most however can be diagnosed, and most can be helped or treated. The problem is that this process may take time, and indeed, it is often a matter of excluding problems, rather than a definitive confirmation of one, that leads to a diagnosis or a treatment option. This explains why it often takes months to work out why some replaced joints are still symptomatic, and even longer to fix them.

**Stiffness** is perhaps the most common problem initially. Given time however, most problems relating to this resolve. Indeed, the range of motion will continue to improve for 12 or more months. If at the 2 month mark however, the knee does not have 90º of bend, then a manipulation under anaesthesia can be performed. This is generally a minor intervention and usually does not make the knee sorer. What it achieves is a breakdown of the restricting scar which, in turn, makes the knee feel freer and less sore. The best time for this is at about the 2 month stage, but it can be left as long as 3 months in some instances. After 3 months the scar gets quite thick and strong, making it harder to break down. This then makes manipulation more difficult and more risky. Accordingly, it is rarely performed after the 3 month mark.

If the knee still ends up with an inadequate bend, despite a manipulation, then it may be possible to remove the restricting scar from within the knee joint using the arthroscope. This is usually not performed before the 9 month mark for fear of stirring the knee up and making it sorer. Indeed, it seems that the optimal time to remove this scar is between 9 and 15 months post surgery; once the knee has settled down and become quiescent. By doing this, increased motion can usually be obtained and, although some of that motion may subsequently be lost, it is usual to maintain over 90 degrees of flexion. Even if not much more motion ensues however, the removal of scar will often make the knee feel less stiff and tight, and this in itself can be a worthwhile improvement.

Clearly, the biggest problem with the arthroscopic approach, is that it has the potential to introduce infection into the knee: hence, it is only offered if the potential for improvement seems to justify that risk. Of course, antibiotics are used in the peri-operative period with this surgery, but this is not an absolute guarantee that an infection cannot be introduced.

**Residual mal-alignment** (a crooked knee) is not very common with today's alignment systems. Most systems can get within 2-3 degrees of accuracy on a regular basis. It is important to note however, that whereas it was once thought important to make the knee perfectly straight (so called ‘Mechanical Alignment’), it is now thought to be more important to balance the ligaments on each side of the knee such that they are not too loose nor too tight (so called ‘Kinematic Alignment’). In essence, this means taking the knee back to an alignment similar to the one that existed prior to the arthritis leading to deformity and change of alignment.

The aim of kinematic alignment is to balance the ligaments without having to release them. Only where the resulting alignment is thought to be unacceptable, either from a functional or cosmetic standpoint, are ligament releases performed. This then allows the alignment to be brought within what would be regarded as an optimal or acceptable range, but without excessive tension on the ligament that would otherwise have been tight.

Soft tissue releases, freeing up the tight and scarred ligaments from the bone, is much easier to perform in the varus (bow legged) knee than the valgus (knock knee deformity) knee because a more complete release of the affected tissues can be performed with safety. In the very valgus knee, some structures on the outside of
the knee can be released, but the lateral ligament should not be released for fear of causing instability. If the valgus deformity is severe, and not correctable by standard releases, a shift the lateral femoral epicondyle, with the origin of the lateral ligament attached, can be performed. In doing this, the origin of the lateral collateral ligament can be shifted, thus loosening up that side of the knee. The piece of bone on which that ligament hangs can then be fixed back to the femur, thus allowing significant correction of the malalignment without causing instability.

If this approach doesn’t work, then a prosthesis with extra inbuilt stability can be used instead of a standard prosthesis. This is a so-called constrained prosthesis

**Swelling** is normal within the knee and may last 6 - 9 months. Swelling of the leg and foot also occurs, and sometimes this is more chronic. Generally, this latter problem relates to poor venous or poor lymphatic drainage after surgery. Anyone with bad veins, or who has had swelling in the legs before hand, is at significant risk of having permanent swelling in the leg afterwards. Fortunately however, even when this occurs, it is usually relatively minor.

**Infection** is fortunately uncommon. In most series it occurs in about 2 per 1000 cases, but is higher in those at risk (diabetics, haemophiliacs, those on anticoagulation and so forth). To decrease the risk, all patients are given antibiotics at the time of, and after surgery, and the cement that is used generally contains an antibiotic that leaches out into the knee over several weeks. Special lamina flow air-conditioning systems are required for this type of surgery, which means that not all hospitals, and not all operating theatres, are suitable for this. Other precautions, such as the wearing of fully enclosed space suits, are also taken.

Whilst the knee can become infected at the time of surgery, late infection is probably more common. It is thought that the organisms reach the prosthesis through the blood and land on the metal. Because the metal is not living, the organisms can hide from the body’s defences: and hence can grow and multiply to the extent where a significant infection develops.

If infection occurs, and it is treated acutely, it can generally be treated with a washout of the knee and antibiotics. It is however, hard to totally eradicate the infection, which can sometimes mean life-long suppression with antibiotics. Usually, the polyethylene liner also needs changing to improve the chances of success. The reason for this is firstly, to get to the dead space between the polyethylene component and the underlying metal base plate where organisms can hide, and secondly, because the infective organisms can attach to the polyethylene and be difficult to remove from it.

If this approach does not work, or the problem is chronic, then a 2 stage revision can be undertaken. This is a major undertaking, initially requiring removal of the prostheses and implantation of cement spacers (which contain antibiotics which leach out into the knee over time). This is combined with prolonged intravenous antibiotic therapy which typically lasts 2 months. The antibiotics are then stopped and, if the infection does not return or flare up, the spacers are removed and a new knee is inserted. This has a high chance of success but it is not 100%, and the new knee may never be as good as the first.

**D.V.T.’s (Deep Venous Thromboses)** can occur, and are relatively common if no preventative treatment is given. These represent clots in the deep veins of the leg, usually the calf. They may occur at the time of surgery and then get slowly bigger over several days, or they may come on sometime thereafter. If symptomatic, it is usually as an ache in the calf at the back of the leg. If this is thought to be occurring, then a doppler (ultrasound) scan can be used to investigate it, and, if confirmed, appropriate treatment then organised.

It is to be noted that not every clot in a calf vein is a deep venous thrombosis. A number of these events occur in more superficial veins, such as the soleal veins, where they are unlikely to spread the lungs: and therefore may not need the full anticoagulation required to treat a true deep venous thrombosis.

**P.E. (Pulmonary Embolism)** is a condition in which clots that form in the peripheral venous circulation spread to the lungs and block the small vessels of the lungs. By doing this they can create a significant block to the circulation of the blood through the body, and similarly, they can reduce the amount of oxygen that is taken up from the lungs into the bloodstream. This is a rare event but does represent a major and serious complication of this and other lower limb surgery. In the majority of cases, like DVT’s themselves, it is treatable by thinning the blood. This prevents new clot from forming and allows the body time to slowly dissolve the clot that is present.

Because of the risk of these complications, almost all patients will be given some form of preventative treatment. This usually means a thinning of the blood with a low molecular weight heparin, such as clexane, for the first 5 days. After this, an oral anti-coagulant can be used. Mostly this just means low dose aspirin (100mg taken once a day - e.g. Cartia - for 6 weeks).

If the risk is higher than normal, then other treatment may be advocated. This most usually means changing over to a factor 10a inhibitor such as Rivaroxaban (Xarelto), or Apixaban (Elequis), both of which are approved on the PBS for use after knee replacement. These drugs come in tablet form, and are used for 15 days after the clexane has been ceased.

We have previously tried to use factor 10a inhibitors
It is generally thought that the chance of this giving rise to a significant problem is Revision knee replacement, and difficult primary knees computer navigation. rather favouring the safer (and better) alternative of used this since 1990 for primary knee replacements, currently the most used in the world, Dr Holt has not venous system. Whilst this method of leg alignment is (intra-medullary), thereby increasing the pressure in the requirements of bleeding which are both detrimental to the knee in the longer term, and pose significant risks of bleeding elsewhere in the body. Hence, whilst Surgeons in the United States once used to advocate full anti-coagulation after Joint Replacement Surgery (to try and prevent pulmonary embolism at all cost), there now seems to be a more realistic approach similar to that advocated in this country. This emphasises that the risks should not exceed the benefits.

**Travel after surgery:** It is generally thought that the risk of getting a D.V.T. or a P.E. is increased out to at least three months following surgery. Accordingly, if travel is contemplated in that period of time, then appropriate measures need to be taken. For short to medium distance car travel, the standard post-operative low-dose aspirin should be adequate. Longer car journeys, like aeroplane journeys, may require more aggressive anticoagulation such as the use of rivaroxaban. In addition, flight socks or flight stockings, are advised.

Rivaroxaban is taken 1 - 2 hours before a journey commences, and will give about 18 hours of protection. So, if the journey is longer than that, a second tablet should be taken. If the travel occurs during the period where aspirin is being used, the aspirin can be ceased for the days of travel and replaced with 10mg of rivaroxaban. Of course, if you are travelling away and then returning, the treatment should be repeated on the return journey. Such precautions should be taken for at least three months following replacement surgery, and perhaps a little longer if significant travel is planned.

**Fat embolism** risk is highest in the old alignment systems that require rods to be passed up the centre of the bones (intra-medullary), thereby increasing the pressure in the marrow cavity, and hence squeezing the fat into the venous system. Whilst this method of leg alignment is currently the most used in the world, Dr Holt has not used this since 1990 for primary knee replacements, rather favouring the safer (and better) alternative of computer navigation.

Revision knee replacement, and difficult primary knees requiring the use of stems, are different. In this situation entering the canal cannot be avoided. Fortunately, the chance of this giving rise to a significant problem is small.

**Foot drop** occurs when one of the nerves that cross the side of the knee is stretched, usually in correcting a very valgus (knock kneed) knee. This occurs some 2 - 4% of the time and usually is transient, generally resolving over a period of days to weeks. Long term or permanent foot drop is rare, virtually all having recovered by 3 months.

**Vascular injury** is uncommon, but the artery at the back of the leg, the one that supplies all of the leg below the knee, is just millimeters behind the exposed back of the knee: theoretically therefore, it is at risk. The reality however, is that direct injury to this is rare, most problems relating not to surgical mis-adventure, but to poor blood supply in the first place. This particularly applies to smokers and diabetics and, if the blood supply to the foot in these people is poor, then the limb is at some risk. Despite this however, problems are rarely encountered, hence it would be unusual for poor circulation to actually preclude replacement surgery.

**Failure of the prosthesis** can occur for various reasons but, in the long term, it usually relates to wear of the polyethylene (plastic) component. It is likely however, that modern polyethylene will last at least 20 years (and maybe even 30) if the knee is well looked after. The polyethylene undergoes straightforward mechanical wear and hence, younger more active people will wear it out more quickly than older more sedentary people. That having been said, in most prosthetic systems, worn plastic can be re-replaced without having to replace either of the metal components.

Debris from polyethylene wear may cause reactions in the tissues about the replacement. In its mildest form this means some irritation of the synovial lining of the knee causing some minor aching and swelling. This is usually the first real sign of wear and should indicate the need for a review of the knee to see if polyethylene revision is indicated. This process can go on for months or even years before any significant damage is caused, but sometimes these signs can appear quite late in the process, suggesting that earlier review rather than later, is a good idea.

Occasionally, if left too long, the plastic can wear right through, thus causing the metal components to articulate directly on each other. This in turn leads to scratching and wearing of the metal components, which then have to be replaced as well. It also causes metalosis whereby the metal debris particles not only fill the joint cavity, but seep out into the soft tissues: it also causes an irritation of the synovial lining of the knee: theoretically therefore, it is at risk. The reality however, is that direct injury to this is rare, most problems relating not to surgical mis-adventure, but to poor blood supply in the first place. This particularly applies to smokers and diabetics and, if the blood supply to the foot in these people is poor, then the limb is at some risk. Despite this however, problems are rarely encountered, hence it would be unusual for poor circulation to actually preclude replacement surgery.

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a reason to consider a prosthesis that does not contain chrome cobalt.

Currently, Dr Holt uses a zirconium femoral component with a zirconium Oxide coating (Oxinium® - Smith & Nephew), the latter being a ceramic. Not only is this harder than chrome cobalt, it has better wear characteristics, and the underlying metal itself is better tolerated. It also does not contain any nickel, that being the chief cause of metal allergy: something that is always hard to prove, is perhaps not that common, but if suspected requires a revision to a nickel free prosthesis like Zirconium.

Whilst revision of all components can be done, it is much bigger to do and, because bone is lost during removal of well integrated metal components, there is less bone to support the new components. Of course, there are prosthetic components made specifically for this situation, but the surgery is much bigger and more complicated than it is for a primary replacement.

**Osteolysis** (bone dissolution) and component loosening is, fortunately, very uncommon in knee replacement: and it is predominantly associated with the older style polyethylene components and not the newer 'highly cross-linked' ones in which radiation has been used to fuse the polyethylene molecules together to increase strength.

Essentially, when wear occurs in the polyethylene component, small particles of plastic debris are distributed throughout the joint. These debris particles incite the body to make chemicals (prostaglandins) in order to try to remove or dissolve those particles. As one can imagine however, the plastic is relatively immune to this sort of attack, whereas the bone is not. Hence, with time, the bone around the edges of the prosthesis may gradually be eroded, eventually leading to large cysts in the bone, and loosening of the components. Should this happen to a significant degree then, eventually, either the replacement will come loose, or the bone will fracture, or both.

The above situation requires a full revision of all components, and possibly some bone grafting of any cysts. It means using revision prostheses that include stems; with or without augments to make up bony deficiencies. In addition, because the soft tissues and ligaments are often damaged, the prosthesis that is chosen may well need to be constrained to provide extra stability: or even a hinge if ultimate stability is required.

Knowing the above, it is important to realise that, if there is any suggestion of wear (increased pain and swelling), then early consultation should be sought.

**Summary**

Knee replacement is a commonly performed and generally very successful procedure. It does have complications but most of these can be avoided, minimised or treated. For those with severe arthritic pain or deformed knees, the risks are generally well outweighed by the benefits.

Further information can also be obtained on this and other related topics, such as:

- Knee replacement - the hospital journey
- Pain management after knee replacement
- Rehabilitation after knee replacement
- Knee replacement after discharge
- Bilateral knee replacement
- Infection after knee replacement
- and more

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