



## **Revision Knee Replacement Using Pile Foundation Technique**

Dr. Ravi Sankar Kirubanandan<sup>1\*</sup>, Dr. Javed Abdulla<sup>2</sup>, Dr. Kalaivani Kumaresan<sup>3</sup>

*1. Arthroscopy, Trauma & Joint Replacement Surgeon, M.B.B.S., MRCS, D. ORTHO, D. SICOT, FRCS (TRAUMA & ORTHO), Lifeline Multispeciality Hospitals, Kilpauk, Chennai, Tamilnadu, India.*

*2,3. Intern Doctor – M.B.B.S,*

**\*Correspondence to:** Dr. Ravi Sankar Kirubanandan, Orthopedic Department - King Hussein Medical Center Amman-Jordan.

### **Copyright**

© 2023 **Dr. Ravi Sankar Kirubanandan**. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Received: 23 June 2023

Published: 10 July 2023

**Abstract**

*Revision total knee arthroplasty presents numerous technical challenges and decisions for the operating surgeon. Preoperative planning includes clinical evaluation of deformity, range of motion gait, ligament laxity, pain score, critically reviewing radiographs identifying bone loss by CT scan, Gustilo - Anderson classification.*

**Keywords:** *Knee replacement, Revision knee replacement, Revision surgery, Pile foundation Revision knee replacement technique, Novel Revision knee replacement technique.*

**Case History**

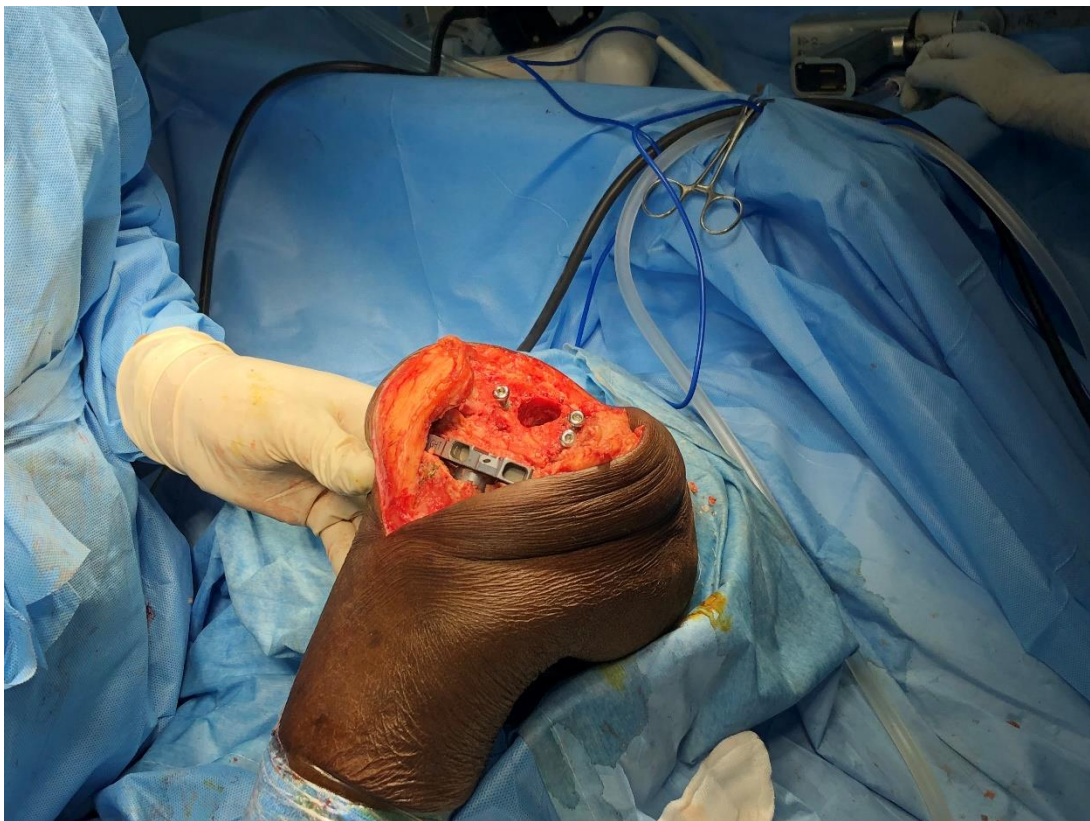
Patient had a right total knee replacement surgery 5 years ago with no post-operative event and was discharged with no complaints after the index surgery. Since last three years, he had complaints of gradual on-set of pain, difficulty in walking, There is occasional swelling. After a certain period of time the pain was quite significantly worse, then gradually he started to walk only with a support. So primary was done included a Xray, clinical evaluation, range of motion, gait, pain score. The imaging investigation which was taken during the primary management revealed loosening of prosthesis including both femoral component and Tibial component, so he was been observed in another centre. when he presented to us, he was having severe pain and significant swelling, fixed flexion deformity of 20 degrees, range of movement 20 -75 degrees, further movement is painful and restricted, no distal neurovascular deficit, wasting of quadriceps muscle and antalgic gait. He was using a walker for support for minimal mobilizations with walking distance less than 50 feet. We took a Xray which revealed osteolysis and lateral movement of femoral component and lateral breach of cortex of distal femoral lateral condyle and there's tibial osteolysis and sinking of the prosthesis in medial tibial plateau. There was mild osteoporosis in patella and proximal tibia due noted.







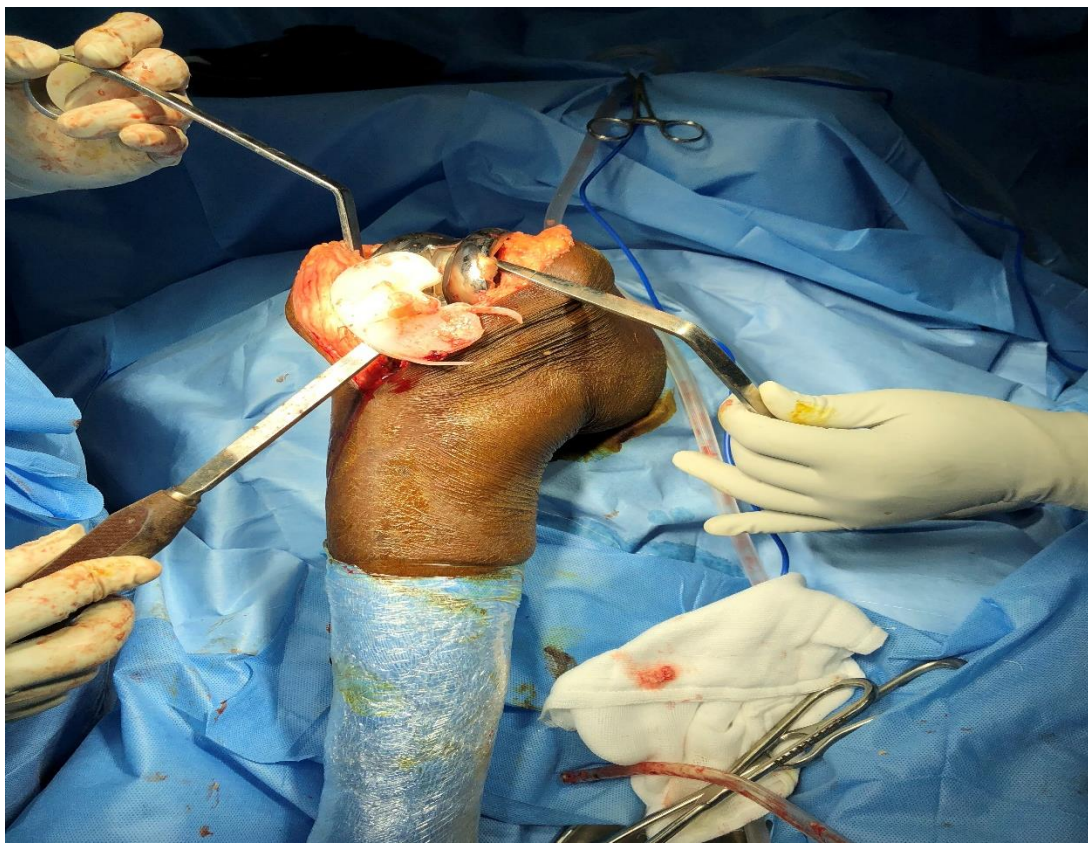
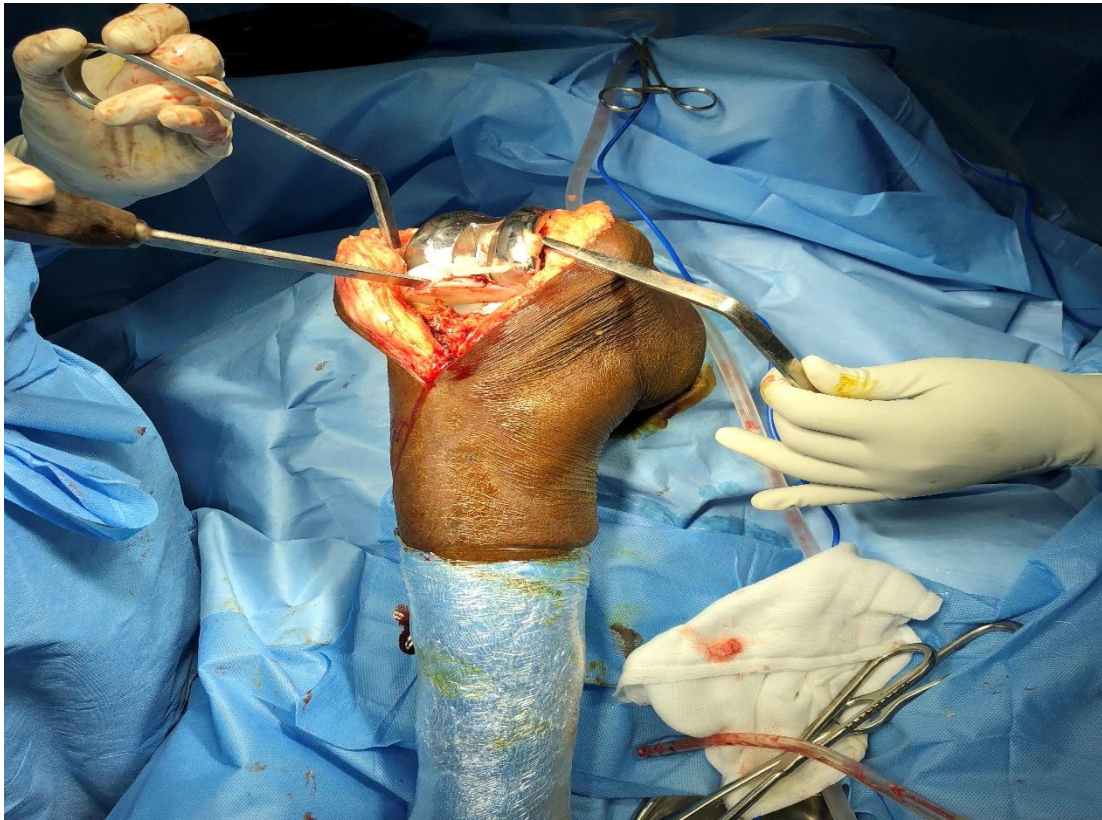












Dr. Ravi Sankar Kirubanandan (2023). Revision Knee Replacement Using Pile Foundation Technique. *MAR Orthopedics* (2023) 5:3



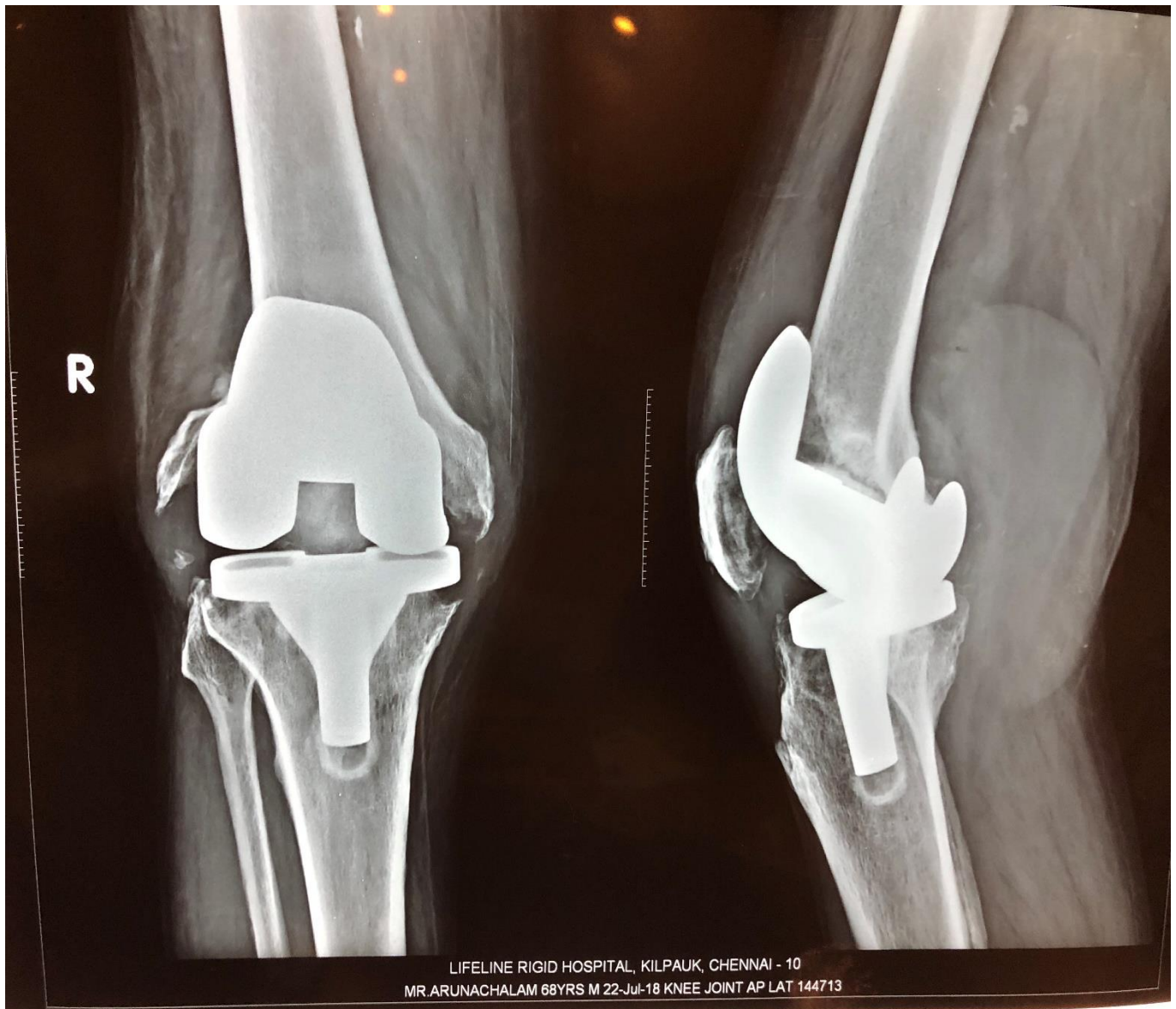














### **Pre-Operative Planning**

The patient was first given some pre-operative scorings which included

1. Oxford knee score of 9
2. KOOS score of 29%
3. Lysholm score of 7%
4. IKDC score 25.3%
5. WOMAC Pain score of 31.1



The imaging investigations were revealing huge bone loss which was then classified. In the literature several classifications are reported for quantifying and defining the type of bone defect. Currently the most widely used is the classification of the Anderson Orthopedic Research Institute (AORI) that represents the evolution of the Engh classification. In AORI classification development the authors wanted to create a classification that follows the criteria of simplicity and reproducibility and orientates the surgeon to the solutions to be taken in each type of defect. In this classification the femur (F) and the tibia (T) are considered separately, but with the same distinct deficit: type 1 (F/T), in which the bone is intact metaphyseally and there are minor defects that do not affect the stability of the implant, where it is preferable to use implants for the primary; and type 2 (F/T) where the metaphyseal region is damaged with loss of cancellous bone that can affect a condyle or tibial half plate (F/T2A) or both (F/T2B); F/T2A and F/T2 require a reconstruction with the use of cement, bone graft or a substitution with augmentation to restore the joint line and the stability of the knee. Instead in type 3 defects (F/T) there is a resorption of the metaphyseal portion with both condyles or tibial half plates impaired. In this severe defect allografts may be associated with detachment of the collateral ligaments or patellar tendon and therefore bound structural or modular implants are necessary.

As per the classification of the Anderson Orthopedic Research Institute (AORI) the bone loss for the patient is classified as F3/T2a. So, we had to refer to all the available options which is used for total knee replacement with such a huge bone loss.

The available techniques are

1. Cementation
2. Modular metal augmentation
3. Autologous bone grafting
4. Allogenic bone grafting
5. Impaction bone grafting
6. Structural bone allograft
7. Porous titanium metaphyseal sleeves
8. Porous tantalum metaphyseal cones
9. Mega prosthesis/customized prosthesis

**NOTE: DISADVANTAGES WILL BE DICUSSED LATER**

After viewing all these available options, we came to to our own novel technique called as pile foundation / scaffolding technique . It was inspired by a civil engineering principle . we felt this case would benefit such a novel technique . after going through all the pros and cons , we decide to work with this technique.

## **Discussion**

### **Our case technique**

### **Complaints**

Right knee swelling and pain progressive for 1 month.

Difficulty in walking for 1 week,

History of fall in bathroom.

### **Past-History**

History of right TKR 13 years back.

History of left knee surgery 25 years back.

History of bilateral cataract 15 years back.

### **Co-Morbidity**

Known case of CAD-Post PTCA on treatment.

Known case of type 2 diabetes mellitus for 20 years on treatment.

Known case of hypertension for 20 years on treatment.



Patient was planned for revision total knee replacement with stem in femur and stem in tibia. Pre-op workup was done, fitness was obtained, 2 units of blood reserved and patient was taken into operation theatre. On examination under anesthesia, he had significant medial collateral ligament laxity of about 0°-40° correctable to neutral and the fixed flexion deformity was manipulated preoperatively and range of 0° -90° was achieved before incising the skin. On account of significant femoral prosthesis loosening there was anterior and posterior laxity.

After incision, femoral prosthesis was removed without difficulties, tibial prosthesis was slight embedded in proximal tibia which was removed with fine depuy osteotome, followed by which bone loss was noted where there was complete loss of lateral femoral condyle and almost 50% loss of medial femoral condyle and notch was widened for twice the size as in posterior stabilization of the knee. Semi constrained long stem femoral and tibial implant by Smith and nephew legion revision system was planned. In any revision knee including Smith and nephew legion the amount of augment available for anterior distal and posterior is maximum of 20mm since in this case the defect is more than 40 mm the other options included metaphyseal fitting knee replacement where a cone has to be made in distal femur or else distal femur resection and complete distal femur replacement. All these procedures could cause more risk to the patient, prolonged duration of surgery ,increased chances of infection as well high cost.

Hence in order to avoid all these complications as well achieve stability of distal femur, A novel technique called Scaffolding or pile foundation was adopted. Pile foundation is a well-known technique used by civil engineers to provide strong foundation where the soil is loose r unhealthy or in a case where a long deep stand-alone foundation can't be done ,so in such case they do multiple drilling is done the ground for area of 10×10 where 6-7 pile foundation is drilled for about 30 feet below and normal foundation is laid on top of it.The principle of this technique is that it distributes the forces equally and amount of digging of soil for 30 feet could be minimized.

This technique is extrapolated in this case where 4 long cortical/cancellous screws of about 50mm in size are drilled along medial and lateral femoral condyle of 2 in number on both sides each, this provides elevation of femoral bone loss from 40mm to about 15-20mm.On top of these screws augment of 20mm was used, it was made sure that augment wasn't in direct contact with screw but interfaced sufficiently by palacos gentamicin loaded cement. Femoral and tibial cementation was done separate, care was taken so that screw doesn't touches the augment.

Cementation is done to prevent fretting . it is a type of corrosion occurred when a moving metal hits another moving metal. Femoral implant was done and found to be stable. For tibia pile foundation wasn't needed , size 2 legion prosthesis was used along with the stem but without offset, knee was stable intraoperatively on trial reduction followed by original implantation after which knee was found to be stable. The significance of this case is to highlight the usage of Scaffolding/pile foundation technique which is helpful for elderly where bone loss can be reduced by using simple conventional semi constrained long stem knee replacement and avoiding high end procedures such as metaphyseal cone or distal femur replacement. Patient was on regular follow up and after 3 years the patient is able to walk pain free

**Anesthesia:** spinal + local infiltration.

IV Antibiotics given

Tourniquet time: 2hr 05mins

### **Examination under anesthesia**

-Varus=25 degrees with lateral subluxation

-FFD=30

-ROM=30-50-degree painful thereafter

### **Procedure**

**Approach:** Midline para patellar

**Findings:** Loose femur and tibia –large femoral bone loss both medial and lateral condyles, MCL lax but intact, complete wear out of the medial poly insert with lots of poly debris with soft tissue swelling, femur and tibial cuts were performed. 10 mm lateral condyle augment +5mm medial augment with supporting 4.5mm cortical screws used as skeleton with 12mm stem-size 4 femur size 3 tibia with 11mm insert done, stable knee cementing done in sequential tibia followed by femur, patella already resurfaced left intact.

ROM 0-110 degree on table, drain kept.



**Stable** –in flexion and extension, midflexion confirmed before closure.

**Closure:** No1 vicryl, clips for skin.

**Post Operative Period:** Uneventful . Patient mobilized on POD 1 , ROM from POD 2 Hence , he was discharged with advice medications and follow up.

## Conclusion

One of the most common issue which is faced during a revision knee surgery is bone loss. The management of bone loss is very essential to maintain the stability and longevity of the prosthesis which is implanted and to give a better result than the prior done surgery. Methods of bone loss managements are selected according to the specific requirements of the given case, by looking at the amount of bone loss , the viability and quality of the bone and other factors . The available techniques were Cementation, Modular metal augmentation, Autologous bone grafting, Allogenic bone grafting, Impaction bone grafting, Structural bone allograft, porous titanium metaphyseal sleeves, Porous tantalum metaphyseal cones, Mega prosthesis/customized prosthesis. But we have opted this new pile- foundation / scaffolding technique by looking at this specific case where we have huge bone loss in femoral compartment as well as the medial tibial compartment operated at our centre. So we inspired this techniques from civil engineering principle and made it to fit into orthopaedics. We had a continues follow up for five years post-surgery. The patient had a complete relief in all primary complaints like immobility, stability issues, pain , swelling .The patient was able to walk properly and continue his regular pattern of lifestyle with following pain score difference.

## References

1. Panegrossi G, Ceretti M, Papalia M, Casella F, Favetti F, Falez F. Bone loss management in total knee revision surgery. *Int Orthop*. 2014 Feb;38(2):419-27. doi: 10.1007/s00264-013-2262-1. Epub 2014 Jan 10. PMID: 24407821; PMCID: PMC3923937.
2. Lee, Y.S. and Chen, A.F., 2016. Managing bone loss in revision total knee arthroplasty. *Annals of Joint*, 1, pp.17-17.
3. Dennis, Douglas A. MD; Berry, Daniel J. MD; Engh, Gerard MD; Fehring, Thomas MD; MacDonald, Steven J. MD; GlenRosenberg, Aaron MD; Scuderi, Giles MD. Revision Total Knee Arthroplasty. *Journal of the American Academy of Orthopaedic Surgeons*: August 2008 - Volume 16 - Issue 8 - p 442-454
4. Thienpont E. Revision knee surgery techniques. *EFORT Open Rev*. 2017 Mar 13;1(5):233-238. doi: 10.1302/2058-5241.1.000024. PMID: 28461953; PMCID: PMC5367533.

