Debridement: Defining something we all do

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In the modern management of orthopaedic infection, debridement and the ritual of the reproducible steps that go with it are paramount. Debridement is defined in the Oxford Dictionary of the English Language as ‘the removal of damaged tissue or foreign objects from a wound’. It derives from the original French *debridement* (1835-45), literally to take away the bridle.

The ‘ritual of the surgical operation’ was described by Lord Moynihan almost 100 years ago1. All aspects of surgery can be enhanced by ritual or, as we would see it today, a repetition of a defined technique to achieve reproducible outcomes. Debridement of the infected total knee replacement (TKR) is no different.

We strongly believe that the debridement is the most important determinant of successful infected TKR surgery, whether it is performed to retain implants as part of a DAIR (debride, antibiotics and implant retention) procedure, or performed for a single- or two-stage revision procedure. The re-infection rate following a single-stage revision TKR is falling2, and one possible reason for this is the better understanding of, and greater attention to debridement.

Debridement can be divided into superficial and deep3-5. Superficial wound debridement can be sub-divided into *autolytic* (hydrogels and auto-enzymes), *enzymatic* (streptokinase and collagenase), and *biological* (maggot therapy). Deep wound debridement is sub-divided into *surgical*, which includes explantation and sharp dissection, *mechanical*, curettage and reaming, power lavage and optionally hydrogen peroxide (H₂O₂), and chemical, such as acetic acid and honey.

It is important to appreciate the soft tissue envelope as failure to do so may lead to poor wound healing and subsequent compromise of deep tissues6,7. It is also important to appreciate that debridement is separate from this and must not be compromised by thoughts of reconstruction. In this article we will concentrate on the role of deep debridement in the management of the infected knee replacement.
1. Surgical debridement

An adequate debridement of an infected knee requires an extensile approach which accommodates previous skin incisions. As a general rule, previous incisions are used if adequate, and extended proximally and distally as needed. The senior author favours a Tibial Crest Osteotomy to improve access to both explant and debride all corners, whilst protecting the extensor mechanism. Broad scars should be excised in a mobile joint but caution is required in the stiff and tethered knee. Sinuses in the line of incision should be excised. Isolated sinuses elsewhere should be curetted and the deep sinus tract excised. All curetted sinuses will heal if adequately debrided and the source of infection removed. Occasionally, plastic surgical coverage must be planned for when potentially non-viable or necrotic skin is present; a medial gastrocnemius rotational or pedicle flap is generally sufficient.

When dealing with infected arthroplasty, explantation is akin to sequestrectomy and must include all implants and necrotic bone. Flexible osteotomes are best to take down the implant-cement interface, although sharp rigid osteotomes should be available. Sharp dissection involves a thorough synovectomy and excision of all visible infected membrane or biofilm. Blocking the medullary canals with a swab prevents debrided material from entering them. Ligaments are vascular structures and do not routinely need to be excised. Only when explantation and sharp dissection has been completed can the next stage of debridement begin.

All tissue removed at debridement has the potential for bacteriological sampling. Again a consistent protocol is useful to improve sensitivity and specificity. The authors’ protocol is to obtain the following samples in order: 1- joint aspirate, 2- synovial samples (x2), 3- femoral joint surface tissue, 4- tibial joint surface tissue, 5- tibial canal membrane, 6- femoral canal membrane. A total of 6 to 7 samples are obtained with non-contaminated instruments.

2. Mechanical debridement

Mechanical debridement has several distinct stages. The femoral and tibial joint surfaces and intra-medullary canals are curetted of any residual membrane, avascular bone and cement residue. The pre-operative radiographs are useful to identify material invisible to the naked eye. The femoral and tibial intra-medullary canals are then carefully power-reamed to remove persistent neo-cortex and membrane in a compartmental debridement as described by Lautenbach.

Hydrosurgical debridement is performed next with high-pressure fluid, commonly sterile saline. All joint surfaces and canals are lavaged under power using the appropriate nozzle attachments. Lavage of the soft tissues, joint surfaces and the intra-medullary canals must be performed in a sequential manner. Most surgeons prefer saline but other solutions with added chemicals or antibiotics can be used according to preference. The volume of pulse lavage fluid used is less important than where and how the operative field is lavaged. Pulse lavage has a tidal effect of washing loose debris away from the operating field but more importantly lavage under power makes any infected membrane adherent to bone oedematous. Oedematous membrane is easier to both see and to debride with a further cycle of curettage and reaming. Mechanical

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Table 1: Methods of debridement
WE STRONGLY BELIEVE THAT THE DEBRIDEMENT IS
THE MOST IMPORTANT DETERMINANT OF SUCCESSFUL
INFECTED TKR SURGERY, WHETHER IT IS PERFORMED
TO RETAIN IMPLANTS AS PART OF A DAIR (DEBRIDE,
ANTIBIOTICS AND IMPLANT RETENTION) PROCEDURE,
OR PERFORMED FOR A SINGLE- OR TWO-STAGE
REVISION PROCEDURE.

Debridement should be seen
cycling with a minimum of
two, and possibly three cycles
required to achieve adequate
mechanical debriement (Figure 1).

Hydrogen peroxide is used for
the mechanical effect of oxygen
release producing effervescent
cleaning and theoretical biofilm
degradation and cell wall
penetration\(^\text{13}\). Controversy
remains over the risk of air
embolus whilst using hydrogen
peroxide, although this risk
is mitigated by the use of a
tourniquet. If hydrogen peroxide
is used the authors recommend its
use after the cyclical mechanical
debridement and prior to chemical
debridement, allowing the biofilm
and organisms to be presented
for a chemical onslaught.

3. Chemical debridement

Chemical debridement is the final
part of deep debridement and
seeks to create a hostile chemical
environment that further degrades
residual biofilm, as well as killing
and preventing further bacterial
growth. Although several options
are available, the senior author
prefers 3% Acetic Acid\(^\text{14,15}\) which
lowers the environmental pH
and has activity against both
Gram negative and positive
microorganisms. Generally
a 10 to 20 minute acetic acid
soak before reimplantation is
sufficient. Another option is
SurgiHoney\(^\text{16,17}\) which works
by a local osmolar effect
but also produces hydrogen
peroxide. SurgiHoney\(^\text{16}\) also
has the potential to be used as
an antibacterial coating after
re-implantation. Other potential
chemical debridement agents
include alcoholic betadine,
chlorhexidine and hypochlorite.

Conclusion

Debridement is as much a
formal part of any revision as is
the reconstruction of bone loss
and soft tissue balance. By
having defined stages which
include surgical, mechanical
and chemical debridement,
the thorough and reproducible
debridement is possible. It is
important to understand that
achieving adequate clearance
of infection in a single pass
may not be possible and this
underpins the concept of
repeated cyclical debridement.
Finally, debridement should
be seen as separate from
reconstruction, which should
not be prejudiced by inadequate
debridement.

Debridement is the most important
step in a sequence of events,
but all the other components
of management including a
multidisciplinary approach,
optimisation of the patient’s
medical comorbidities, appropriate
antibiotic sampling and therapy, and
definitive implantation are all also
essential to ensure a good result.

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References:

References can be found online at
www.boa.ac.uk/publications/JTO
or by scanning the QR Code.
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