Case report

Out with the old and in with the new: case report demonstrating tissue expansion facilitating complex revision total knee arthroplasty

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Abstract

Introduction

Tissue expansion is one method of allowing primary closure in areas of problematic healing and tissue loss. We report a case of using a tissue expander to facilitate revision of a right total knee arthroplasty in a patient with rheumatoid arthritis.

Case report

A 47-year-old lady presented to an orthopaedic service three years ago with a severely painful right knee. The patient had undergone a right total knee arthroplasty 12 years previously, which unfortunately became infected and was treated by antibiotics, and a medial gastrocnemius flap with split thickness skin grafting. The patient had a loose prosthesis and no active flexion and soft tissue coverage. Due to numerous urological co-morbidities soft tissue advancement. Due to the knee is stable with good rotation, which allowed up to 4 cm of thickness skin grafting. The patient is currently pain free and the knee is stable with good active flexion and soft tissue coverage. The patient has recently undergone a second procedure to reconstruct the extensor mechanism, with a bone and soft tissue allograft. A bi-pedicled flap was used at this time to close the wound as the soft tissues had been previously ‘expanded’.

Conclusion

We demonstrate this rare use of tissue expansion with prolonged period of implantation with no complications, as well as the need for closer collaboration between plastic and orthopaedic surgeons.

Introduction

Good quality soft tissue coverage is an essential principle in all fields of surgery, be it the closure of a laparotomy wound or that of an arthroplasty. The cornerstone principles of ensuring good wound healing are taught to every surgical trainee to avoid the disastrous consequences of wound dehiscence. These principles are based on having healthy soft tissues in the first instance, but this is not always the case. Factors such as previous operations, trauma and infection can lead to poor quality fibrous and contracted soft tissues from the outset. Naivety to such a factor prior to an operation can predispose to such aforementioned wound complications, jeopardising the success of any underlying procedure. Many options exist for improving the quality and quantity of soft tissues available, including rotation flaps, microvascular-free flaps and tissue expansion1.

Tissue expansion was first described in 1957 by Neuman when he utilised an implantable, inflatable silicon device with a remote injection port2. This technique was further popularised by Radovan in 1984, adding further experience to the literature3. Such expandable devices increase subcutaneous tension, thus stimulating the growth of subcutaneous tissue and skin resulting in an absolute increase in surface area and volume4,5,6. This technique is used extensively in breast, head and neck surgery. Novel uses of tissue expansion were reported in 1987 by Weinzeid et al. to facilitate total arthroplasty due to traumatic tissue loss, and in 1990 by Atar et al. to allow paediatric foot reconstruction5,6.

Complex revision arthroplasty procedures are becoming increasingly common and offer many challenges, including problematic soft tissue coverage and extensor mechanism reconstruction. The majority of revision procedures are performed on patients who have undergone multiple surgical procedures with associated scarring and contracture of the affected joint. The first report of using tissue expansion in a revision knee arthroplasty was in 1997 by Santore et al. who described such a procedure following wound infection1. The largest review of tissue expansion facilitating revision arthroplasty (29) shows a 21% incidence of minor complications associated with the tissue expander (skin erythema and blistering) and one episode of a major complication of skin necrosis7. The same study showed an 18% incidence of minor complications with the revision arthroplasty procedure following tissue expansion, including persistent post-operative drainage and haematoma formation in the pocket created by the expander

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A complex revision procedure, as the soft tissue coverage in anticipation of surgery opinion was sought regarding the extensor mechanism. Plastic apparatus was harvested to replace proximal tibial allograft with attached dure, as opposed to an arthrodesis. A revision to be the best functional proce with a hinged prosthesis was consid and scarred. A revision arthroplasty was extensively contracted, friable over the anterior surface of the knee ruptured patella tendon. The skin a migrated patella, indicative of a cant metaphyseal bone stock loss and loose tibial component with signifi graphs of the knee demonstrated a no active knee extension. Plain radiographs on weight bearing and had collapsing into a gross varus deformity on weight bearing and had no active knee extension. Plain radiographs of the knee demonstrated a loose tibial component with significant metaphyseal bone stock loss and a migrated patella, indicative of a ruptured patella tendon. The skin over the anterior surface of the knee was extensively contracted, friable and scarred. A revision arthroplasty with a hinged prosthesis was considered to be the best functional procedure, as opposed to an arthrodesis. A proximal tibial allograft with attached patella tendon, patella and extensor apparatus was harvested to replace the extensor mechanism. Plastic surgery opinion was sought regarding soft tissue coverage in anticipation of a complex revision procedure, as the residual soft tissues did not appear adequate. Attempting primary closure of the wound with such brittle soft tissues would have significantly increased the risk of dehiscence, infection and other associated complications. Tissue expansion was considered as an appropriate technique to provide adequate soft tissue coverage, which allowed for primary closure, gave an exact skin pigmentation match and avoided donor site morbidity. The risks with tissue expansion included expander rupture, infection and tissue ischaemia. A meta-analysis of tissue expansion shows that the lower limb is at increased risk of such complications compared to other anatomical areas. In June 2009, a standard 340 cc capacity rectangular tissue expander 6 cm x 10 cm was implanted over the medial aspect of the right knee in a sub-fascial pocket and incrementally inflated to 300 ml capacity (Figures 1 and 2). This techni que allowed approximately 4 cm of healthy soft tissue advancement. Due to numerous urological co-morbidities, including recurrent UTI’s, related to bladder polyps and hydronephrosis the tissue expander was not removed and remained in-situ for two years resulting in remarkably healthy soft tissues with no associ ated complications. In advance of revision surgery, inflammatory markers (erythrocyte sedimentation rate and C-reactive protein) were taken which although minimally elevated were thought to be more likely due to co-morbidities than a reactivated wound infection. A joint aspiration was performed to exclude low grade sepsis and this was normal. In August 2011, the patient underwent removal of the tissue expander, debridement of all friable scar tissue and direct exchange of the loose prosthesis and implantation of a St Georg rotating hinge knee prosthesis (Figure 3). The excess surface area and volume of soft tissue afforded by the expander allowed for all poor quality soft tissues to be debrided and primary closure achieved with minimal tension. The wound healed with no complications (Figure 4).

The patient recovered well resulting in a pain free and stable right knee with good soft tissue coverage (Figure 5).

Case report

A 47-year-old woman had undergone previous right total knee arthroplasty in 1996 due to rheumatoid arthritis. After the index operation, the patient suffered a post-operative methicillin resistant 

Staphylococcus aureus wound infection with subsequent skin necrosis. A medial gastrocne-mius flap was utilised with overlying split thickness skin grafting to provide soft tissue coverage after the infection was treated by soft tissue debride ment.

Twelve years after the index procedure, the patient presented to an orthopaedic service in the North of England with a grossly unstable right knee, requiring two crutches and mobilising only short distances. The patient’s right lower limb was collapsing into a gross varus deformity on weight bearing and had no active knee extension. Plain radiographs of the knee demonstrated a loose tibial component with significant metaphyseal bone stock loss and a migrated patella, indicative of a ruptured patella tendon. The skin over the anterior surface of the knee was extensively contracted, friable and scarred. A revision arthroplasty with a hinged prosthesis was considered to be the best functional procedure, as opposed to an arthrodesis. A proximal tibial allograft with attached patella tendon, patella and extensor apparatus was harvested to replace the extensor mechanism. Plastic surgery opinion was sought regarding soft tissue coverage in anticipation of a complex revision procedure, as the residual soft tissues did not appear adequate. Attempting primary closure of the wound with such brittle soft tissues would have significantly increased the risk of dehiscence, infection and other associated complications.

Tissue expansion was considered as an appropriate technique to provide adequate soft tissue coverage, which allowed for primary closure, gave an exact skin pigmentation match and avoided donor site morbidity. The risks with tissue expansion included expander rupture, infection and tissue ischaemia. A meta-analysis of tissue expansion shows that the lower limb is at increased risk of such complications compared to other anatomical areas. In June 2009, a standard 340 cc capacity rectangular tissue expander 6 cm x 10 cm was implanted over the medial aspect of the right knee in a sub-fascial pocket and incrementally inflated to 300 ml capacity (Figures 1 and 2). This technique allowed approximately 4 cm of healthy soft tissue advancement. Due to numerous urological co-morbidities, including recurrent UTI’s, related to bladder polyps and hydronephrosis the tissue expander was not removed and remained in-situ for two years resulting in remarkably healthy soft tissues with no associated complications. In advance of revision surgery, inflammatory markers (erythrocyte sedimentation rate and C-reactive protein) were taken which although minimally elevated were thought to be more likely due to co-morbidities than a reactivated wound infection. A joint aspiration was performed to exclude low grade sepsis and this was normal. In August 2011, the patient underwent removal of the tissue expander, debridement of all friable scar tissue and direct exchange of the loose prosthesis and implantation of a St Georg rotating hinge knee prosthesis (Figure 3). The excess surface area and volume of soft tissue afforded by the expander allowed for all poor quality soft tissues to be debrided and primary closure achieved with minimal tension. The wound healed with no complications (Figure 4).

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Reconstruction of the extensor mechanism with an allograft was not undertaken at this time as the patient’s main desire was for a stable joint. The patient did require an additional procedure following the revision arthroplasty a second stage procedure was undertaken in February 2013 to reconstruct the extensor mechanism, using a composite bone and soft tissue allograft after revision, one drainage procedure of a cystic swelling over the medial aspect of the knee, at the site of the tissue expander, three months post-operatively. Eighteen months

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incorporating patella, patella tendon and extensor apparatus (Figure 6). Due to the previous tissue expansion a bi-pedicled flap was utilised to provide further soft tissue coverage for the large volume of transplanted tissue. The patient was discharged with good soft tissue coverage, a healed wound, active straight leg raise and good flexion.

Discussion
We demonstrate this rare use of prophylactic tissue expansion that eliminates the need for complex flap harvesting and associated complications, as well as a prolonged period of implantation with no complications. Primary closure following revision arthroplasty results in no limitation to the range of movement due to soft tissue tension, allowing for early mobilisation in line with the accelerated recovery programmes in many elective orthopaedic departments.

Conclusion
Wound problems such as dehiscence and necrosis can lead to a failed arthroplasty, infection and in severe cases amputation; all were avoided in this high risk case.

Consent
Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

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References

Figure 6: Plain radiograph of the right knee following allograft implantation and closure with a bi-pedicled flap.