Case report

Delayed onset bioabsorbable screw reaction, intact screw extrusion and *Pseudomonas aeruginosa* tibial tunnel osteomyelitis years after arthroscopic anterior cruciate ligament reconstruction using hamstring graft

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SUMMARY

Postoperative reaction and infection after anterior cruciate ligament (ACL) reconstruction is a rare complication. We report two cases of bioabsorbable screw extrusion and *Pseudomonas aeruginosa* tibial tunnel infection in 17/18-year-old men, 2 and 4 years after ACL reconstruction, respectively. They underwent tibial tunnel debridement, removal of the still intact poly-L-D-lactic acid bioabsorbable screw and subsequent wound closure. Physical examination findings confirmed patency of the hamstring graft. Culture guided antibiotics were completed, and wounds healed unremarkably. Both returned to previous level of activity. Successful treatment is achieved through a logical sequence of management, as well as a multidisciplinary approach to prevent unnecessary secondary procedures and morbidity.

BACKGROUND

Bioabsorbable interference screws have been widely utilised as the fixation of choice for the tibial tunnel in anterior cruciate ligament (ACL) reconstruction. The implant's supposed advantages range from decreasing stress shielding, adaptability of its degradation profile, reduced need for a secondary procedure to remove the implant and reduced MRI imaging noise.¹ These characteristics coincide with the standard for the ideal implant as compatible, mimetic, degradable and durable.²

Despite its advantages, issues regarding local soft-tissue reaction, inflammation and subsequent site pain have been reported with the use of biointerference screws to as high as 5%.³ Arthroscopic ACL reconstructions have very low hardware-related complications and infection rate (from 0.001% to 1.100%), with *Staphylococcus* sp. as the most common pathogen.^{4,5} Revisions are performed in less than 5% of cases. In a review of only 19 reported cases from 1998 to 2015 involving bioabsorbable interference screw complications, only three patients exhibited an intact subcutaneous migration of the screw. Even so, no documented simultaneous intact screw extrusion with tunnel osteomyelitis was reported.⁶ We report two cases of reaction, intact screw extrusion and concomitant

bone tunnel infection of bioabsorbable interference screws on the tibia 2 and 4 years after ACL reconstruction using hamstring graft.

CASE PRESENTATION

There are two patients in this report with similar presentation and course. The first is a 17/M and the second is an 18/M, both basketball varsity players who sustained an isolated unilateral ACL tear on the right knee after basketball training. The patients presented at the clinic 1 month post-injury exclaiming a feeling of recurrent knee instability. Physical examination showed a positive Lachman and pivot shift test on the right knee. All other special tests were unremarkable. Arthrometer readings were significant at greater than 2 mm side to side difference. Due to the patient's desire to return to his previous level of activity, a reconstruction was scheduled after preoperative physical therapy. The ACL reconstruction was done using a quadruple hamstring graft, arthroscopically through medial, lateral and accessory anteromedial portals. The femoral tunnel fixation was achieved through tight-rope endobutton fixation, while the tibial tunnel fixation was done using a bioabsorbable interference screw. The patients completed prophylactic and postoperative antibiotic courses and underwent the standard rehabilitation and physical therapy. The patients were able to progress through the therapy without any untoward incidents and returned to play on the seventh month as per protocol. They were discharged from the outpatient department and was instructed to follow-up with other complaints.

The first patient followed up 18 months, while the second patient followed up 4 years since completion of the physical therapy programme. Both presented with a 1-month history of swelling on the right medial knee on the previous surgical site at the tibia. Progressive implant prominence was palpable with concomitant erythema, but no pain on range of motion, no sinuses or discharge on initial presentation back at the outpatient department. The patients did not experience any fever, respiratory, urinary and other systemic symptoms prior to the first consult at the outpatient department.

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Figure 1 (first patient) (A) Anterior and medial view of the knee and proximal tibia at the clinic, notable screw extrusion without any discharge. (B) Anteroposterior and lateral radiographs of the right knee on presentation. (C) Removed biocomposite screw. (D) Excision of reactive tissue and exposure of tibial tunnel, no signs of infection. (E) Soft-tissue samples sent for culture studies, right most specimen shows the clear synovial fluid. (F) Closed wound using non-absorbable sutures. (G) Anteroposterior and lateral radiographs of the right knee on completion of treatment.

INVESTIGATIONS

Complete blood cell counts were normal, and erythrocyte sedimentation rate and C-reactive protein, however, were elevated over twofold the normal. The patients followed up 1 week later with subsequent epidermolysis, visible extrusion of the interference screw and with surrounding serous discharge (figure 1A, figure 2A-B). Anteroposterior and lateral radiographs of the affected only showcased soft-tissue shadowing (figures 1B and 2C).

DIFFERENTIAL DIAGNOSIS

Given the clinical picture, the consideration at the time was a late surgical site infection, foreign body reaction, to rule out septic arthritis. Provided that the possible infected graft was intra-articular, the index of suspicion for a septic joint was high which prompted an emergent management.

TREATMENT

The patients were immediately admitted on separate episodes at the orthopaedic ward and scheduled for emergency surgery. At the operating room, while the patients were under regional anaesthesia, physical examination was done to reveal a negative Lachman and pivot shift test which likens to a patent reconstructed ACL. The grossly infected site was isolated using sterile drapes. Knee arthrocentesis was done aseptically to reveal

Figure 2 (A) (2nd patient) Beginning epidermolysis and implant prominence. (B) Ruptured epidermis and exposed implant with soft-tissue erythema and discharge. (C) Anteroposterior and lateral radiographs do not show sequestration, but with soft-tissue shadowing from the swelling on the tibial tunnel. (D) Biocomposite screw removed. (E) Reactive tissue removed, debridement done revealing bony ingrowth and fibrosis of tibial tunnel.

Figure 3 (first patient) (A) (T1 Short TI Inversion Recovery (STIR)) (cephalad) Neo-ligament (hamstring graft incorporated in tibial tunnel). (B) Heterogeneous signal on tibial tunnel showing interface of soft-tissue and incorporated graft. (C) (caudal) Mixed attenuation showing debris and probable remnants of osteomyelitis. (D) Coronal view showing no bone marrow oedema. (E) T2 axial view showing interface of tibia tunnel and soft-tissue debris.

clear synovial fluid. Excision of the reactive tissue, removal of the interference screw and debridement were done. Intraoperative findings revealed loose and movable partially extruded but intact bioabsorbable screws; the previous tibial tunnel was already closed with bony ingrowth and fibrosis and no purulent discharge was observed (figures 1C-D and 2D-E). Tissue specimens were taken and sent for tissue aerobic, anaerobic, fungal, mycobacterium cultures and acid fast bacilli smear (figure 1E). The patients were then placed on empiric antibiotics: cefuroxime 1.5 gm IV loading dose, and 750 mg IV every 12 hours while awaiting cultures. The wound was closed and skin closure attained through non-absorbable sutures (figure 1F). Physical examination was repeated and the Lachman and pivot shift test was still negative.

The synovial fluid analysis yielded clear colourless aspirate, and negative for any microorganisms for the gram stain and culture studies. The tissue culture from the tibial tunnel yielded growth of *Pseudomonas aeruginosa* in thioglycollate broth sensitive to piperacillin-tazobactam, ceftazidime, gentamicin and ciprofloxacin. Antibiotics was shifted to ceftazidime 2 gm IV every 8 hours to complete 2 weeks, and then switched to oral chemotherapy using ciprofloxacin 500 mg/tab every 8 hours to complete 2 weeks.

OUTCOME AND FOLLOW-UP

All antibiotic regimens are guided by the hospital's infectious disease service (IDS). Comparison of radiographs before and after the debridement did not show any relative tunnel widening and gross sequestration (figure 1G). MRI after completion of antibiotic treatment showed normal marrow signals, and no synovitis. Heterogeneous signals on the tibial tunnel from the neo-ligament are probably debris or previous evidence of osteomyelitis (figure 3).

The patients underwent the postoperative protocol of the institution as follows: 0–2 weeks: full weight bearing with knee immobiliser in place, continue resisted knee flexion exercises up to 90 degrees; 1 month: leg raises, full flexion extension assisted by rehab but no resisted extension. At 2 months the patients were already allowed weighted squats. Progress to running and jumping by the fourth and fifth months, respectively, and return to play by the seventh month. At the end of the 7-month physical therapy, repeat arthrometer tests showed less than 2-mm side to side difference (normal) for both patients. They returned to previous level of function and cleared to undergo training as a seafarer for the first patient and as a policeman for the second patient. No revision surgeries for ACL reconstruction were required within the 2-year follow-up.

Figure 4 Diagnostic and therapeutic management algorithm.

DISCUSSION

In brief, the use of polylactic acid as the biodegradable polyester, combined with a calcium compound that theoretically induces bone formation and integration, is the backbone of the design of current bioabsorbable screws.⁶ The array of materials has diversified from the base design to the following compounds: poly-L-lactic acid, polyglycolide, poly-glycolide-co-trimethylene carbonate, poly-DL-lactide, poly-DL-lactide-co-glycolide, polylactide carbonate screws and poly-L-D-lactic acid (PLDLA). These bioabsorbable screws through the process of hydrolysis degrade within 1 year. Osteointegration is another issue that may require up to 3 years to complete.^{1 7 8} The main function of the bioabsorbable screw is to secure the graft and uphold stable fixation for an enough time for the graft to incorporate before it degrades. Mismatch in the time for graft incorporation and screw degradation gives way to the development of cysts if rapid degradation, or to lack of bony integration if delayed.^{7 8} There are reports of bioabsorbable screw to soft/bony-tissue reaction from the host response to the degrading polymers subsequently resulting to pre-tibial cysts, effusion, swelling and screw extrusion.^{1 9 10} The biocomposite screw is a trademark absorbable interference screw design and is comprised of 30% biphasic calcium phosphate and 70% PLDLA. Its intended use is for soft-tissue graft fixation using its tapered design to maximise fixation in cortical and cancellous bone.¹ It was the screw utilised on both our patients.

The two cases presented are peculiar because the soft-tissue reaction which is supposedly infrequent in biocomposite screws progressed insidiously to extrusion of a still intact bioabsorbable screw transcutaneously.

As mentioned, the risk of postoperative infection in patients undergoing ACL reconstruction is relatively low at 0.5% for the combined incidence for acute (<2 weeks), subacute (from 2 weeks to 2 months) and late (>2 months).⁴ Local symptoms such as surgical site pain, inflammation and effusion as consistent with our patients have been described as more constant than constitutional symptoms such as fever and chills.⁴ Risk factors for postoperative infection have been collated to include the following: steroid injection, previous surgical site infection,

Learning points

- ▶ Late onset complications such as screw reaction, extrusion and osteomyelitis should be part of the postoperative monitoring protocol and not merely the physical therapy.
- ▶ An index of suspicion regarding those late complications for postoperative anterior cruciate ligament reconstruction patients presenting with local surgical site pain without any constitutional symptoms and normal blood parameters is imperative.
- ▶ Implant choices should be made with caution as new and expensive implants do not necessarily mean less complications compared with previously used devices.
- ▶ A logical treatment algorithm that is independent of specialised equipment must be utilised in managing urgent cases such as periarticular infections.
- ▶ A multidisciplinary approach provides the most efficient and comprehensive treatment strategy for these kinds of patients.

reoperation of the same area, flash sterilisation of instrumentation, unsatisfactory sterilisation and use of post/braided suture configuration with a metallic implant.^{11–15} The only risk factor identified for the patient was the presence of a foreign body in the tibial tunnel. The most common infection in ACL reconstruction is septic arthritis, and as such the approach is thorough debridement, and removal of infected graft. Though favourable outcomes have been described with graft retention after removal of implants for those who developed septic arthritis, a protocol for tibial tunnel osteomyelitis has yet to be elaborated.^{5 16 17} The common causative organisms for infection as a sequelae of ACL reconstruction include *Staphylococcus*, *Peptostreptococcus*, *Enterococcus* and fungal species.¹⁶ *Pseudomonas aeruginosa* is an under-reported causative agent for osteomyelitis.¹⁸

Treatment of localised osteomyelitis involves debridement and curettage which would contribute to tunnel widening and possible graft failure. Thus, the postoperative rehabilitation protocol was similar to a newly reconstructed ACL with the corresponding physical therapy. Despite the theoretical advantages of bioabsorbable screws, caution should be carried out in the use of these devices. Revisiting more economical and inert materials like titanium screws may still have a role in ACL reconstruction.⁶

For the reported cases, the main thrust of treatment was being able to manage the condition urgently without the need for specialised instrumentation. The logical sequence of diagnostic and therapeutic management, as well as the cooperation of the IDS, prevented an unnecessary outright debridement of the intra-articular portion of the knee (figure 4).

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