Case report

Reimplantation of contaminated extruded segment of lateral femoral condyle cleansed with 10% povidine-iodine in complex floating knee injury with excellent outcome: Case report with 2 year follow up

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ABSTRACT

Traumatic extrusion of bone is a rare complication of high energy open fractures, and there are only few studies published in literature on reimplantation of the extruded bone segment. Studies with clear guidelines regarding timing of reimplantation, stabilisation of extruded bone segments, bone disinfection and disinfection techniques are very few. Previous reports describe disinfection using thermal or chemical methods. We present a case scenario of successful reimplantation of an extruded metaphyseal segment of distal femoral condyle following cleaning with copious saline and soaked in 10% povidine-iodine for 20 min in a 21 year old male patient of a complex floating knee injury with excellent outcome based on Karlstrom and Olerud criteria.

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1. Introduction

The management of open fractures remains a challenge due to high rates of infection and delayed union. These risks are further amplified when these fractures result in significant bone loss following a high velocity trauma. These defects may need use of autograft, allograft, vascularised bone grafts, Masquelet technique or distraction osteogenesis for reconstruction.

In situations where a fragment of extruded bone is available with preserved periosteum for reimplantation, this may benefit in maintenance of skeletal and soft tissue length, averting the morbidity associated with autograft harvest and obviating the need for allograft bone or prolonged bone transport procedures. However, there is a heightened risk of infection with the reimplantation of an extruded, contaminated and devascularized bone segment. Here we describe successful reimplantation of an extruded femoral segment after cleaning with copious saline and 10% povidine iodine in an adolescent male. Taking this opportunity

we reviewed the literature for various methods of disinfection of extruded bone fragment and present it here.

2. Case report

A 21-year old, male presented following a road traffic injury, with grade III B open floating knee injury with fracture dislocation and extruded contaminated segment of lateral femoral condyle. There was a 10 cm × 4 cm irregular wound over the anterior aspect of the distal right thigh with no neurovascular deficit. Extruded segment of the lateral condyle femur was found with bare minimal soft tissue attachment and severe contamination sized roughly 6 cm × 4 cm × 1 cm (Figs. 1–3).

As per ATLS protocol patient was stabilised hemodynamically, clinical, blood and radiological evaluation was done and patient was shifted to emergency operation theatre. Culture swab was taken from the wound following which intravenous cefuroxime, amikacin, and metronidazole antibiotics were given as per the protocol. Thorough irrigation of the wound with saline to remove the visible contamination and debris was done, pulse lavage was used and debridement was done. The extruded bone fragment was washed with copious amount of normal saline and visible contamination was removed before soaking it in 10% povidine-iodine for 20 min (Figs. 4–6).

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Figs. 1 and 2. Wound with contamination extruded bone fragment.

Figs. 4 and 5. Preoperative radiograph AP and lateral.

Fig. 3. Extruded bone fragment.

Wound was extended proximally and distally as patella was fractured, knee joint was opened, fracture dislocation was reduced, articular alignment was achieved along with the extruded segment incorporated anatomically, fixed with multiple cancellous inter-fragmentary screws both in femur and tibia, patellectomy done as it was severely comminuted followed by repair of extensor mechanism additional knee spanning ex fix was applied for further stability. Surgery was done within 6 h of the initial injury.

After 48 h as per our protocol patient was taken up for relook debridement and thorough lavage entire wound was opened along with repaired extensor mechanism, second culture swab taken from superficial and deep wounds (intraarticular), debridement was done. Extensor mechanism was repaired with vicryl no. 2, non-absorbable suture material was avoided to minimise the chances of infection, followed by wound closure in layers with drain.

Fig. 6. Post-operative wound status with ex-fix.

The immediate post-operative period was uneventful; all the culture swabs had no growth, antibiotics continued for 10 days. The patient was discharged after 12 days. Regular outpatient follow-up showed excellent wound healing. External fixator was removed after 4 weeks and put on knee mobilisation. Patient had knee stiffness inspite of aggressive physiotherapy, so at the end of 3 months Judet Quadricepsplasty was done which included initial

Fig. 7. Immediate post-operative radiograph after second stage surgery.

Fig. 8. Post-operative radiographs one year surgery showing union.

intraarticular adhesiolysis and followed by extra articular release of vastus intermedius, excision of fibrous tissue to achieve the complete ROM on table. After three months of extensive physiotherapy complete ROM was achieved without any extensor lag, without any signs of infection (Figs. 7 and 8).

Between 16 and 20 weeks there was radiographic evidence of fracture union also good incorporation of extruded fragment. Partial weight bearing was then allowed. By six months post-operatively, complete radiographic evidence of fracture union was achieved and weight bearing on the affected limb was allowed. To our surprise patient neither had any kind of knee instability nor extensor lag. Karlstrom and Olerud scoring was done which showed excellent outcome and at the latest follow-up, he resumed full work to his preinjury level. He was advised removal of screws and an MRI just to assess the ligament status, but was not keen for it.

3. Discussion

On retro analysis of the factors that contributed to the successful outcome in this patient, were the metaphyseal fracture (i.e. cancellous bone), immediate meticulous wound debridement and sufficient antibiotic coverage, adequate disinfection of the extruded fragment, definitive fixation, relook debridement, quadriceplasty,

aggressive physiotherapy as well as the patient's young age with no comorbidities played an important role.

Similar result was reported by Kirkup¹ in which the patella was also fractured. Their follow-up was 2 and 2.5 years. An important point in the case reported here was that the periosteum had remained attached to the surrounding soft tissue. Strange² reported full bone reconstruction following conservative management after extrusion of a full diameter, three-inch long femoral shaft segment, he also stated that "given a periosteum tube, loss of bone does not necessarily infer non-union, and healthy periosteum will replace bone throughout its length in the same way that scars heal, irrespective of their length". Thus even with tags of periosteum attached bone union can be achieved as in our case report (Figs. 9–11).

No clear guidelines exist on disinfection methods for traumatically extruded bone segments intended for reimplantation. Alternative treatment in this case would have been using massive auto or allograft having their own complications.

Rouvillain et al.³ and Mazurek et al.⁴ reported similar success in reimplantation of traumatically extruded metadiaphyseal femoral segments. Rouvillain sterilised an extruded 11 cm meta-diaphyseal femur by autoclaving the bone segment at 121c, 1.3 bars for 20 min, while Mazurek et al. reported chemical disinfection of a 13 cm meta-diaphyseal femur with chlorhexidine 4% soak for a total of 270 mins. Timely fracture union with full functional recovery was also achieved in both cases.

Thermal disinfection by autoclave is a readily available and well established method, but destroys bone osteo-inductivity and largely decreases its mechanical strength. On the other hand, various studies on chemical disinfection using ethylene oxide gas, chlorhexidine, povidine iodine⁶ or gamma irradiation^{7,8} has shown conflicting results regarding disinfection efficacy and there exist no clear guidelines regarding substance concentration and duration for exposure.

Figs. 9–11. ROM after 2 years.

Fig. 9–11. (Continued).

In our case we soaked bone fragment in 10% povidine-iodine for 20 min; Mazurek used chlorhexidine instead to achieve disinfection. This technique can be very effective with minimal cost even in developing countries. Most of time the extruded loose bone fragments is not used for replacement. This case documents the fact that use of extruded fragment can be successful with excellent functional recovery.

3.1. Take home message

Restoration of anatomy, biology and biomechanical stability with timely intervention was crucial in achieving the excellent outcome even in such complex injury with extruded bone. Thorough pulse lavage and cleansing with 10% povidine-iodine of extruded bone fragment was key. 10% povidine-iodine is easily available and can be reliable means of disinfection in such emergencies.

Conflicts of interest

The authors have none to declare.

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