

Infected Gap Non Union of Radius Treated with Modified Nicoll's Technique-A Case Report

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ABSTRACT

Management of atrophic non union of forearm bones is a challenging task. Various methods of treatment available in the literature are cortical tibial graft (Boyd), ulnar segment graft (Miller and Phalen), iliac crest graft (Spira), cancellous insert graft (Nicoll), vascularized fibular graft (Jupiter), and bone transport by ring fixator (Tesworth). We here report a case of infected non union of radius managed with modified Nicoll's method. Here, intra medullary nailing is preferred over plating which was originally described by Nicoll. At two years follow up, the patient is symptom free and is able to carry out his daily activities with ease.

Keywords: Iliac crest bone graft, Intra medullary fixation, Sequestrum

CASE REPORT

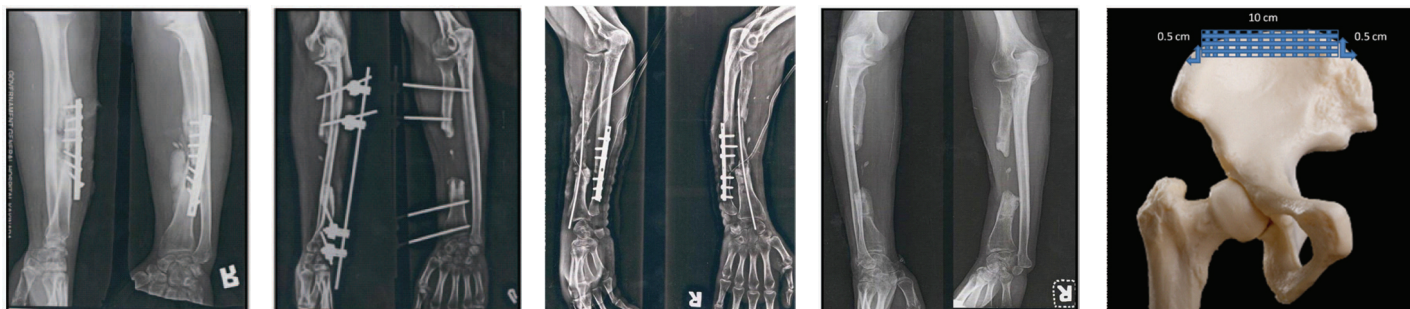
A 27-year-old male patient presented to our OPD with an infected gap non union of middle 1/3rd region of right radius with one discharging sinus through which a part of sequestrum is exposed. There was no history of passage of any dead bone through the sinus. The sinus was situated in the centre of the previous surgical wound. X-ray revealed a segment of dead necrosed bone under the plate [Table/Fig-1]. He was previously operated elsewhere and was found to have undergone repeated surgical interventions with plating and bone grafting. At the time of presentation he was found to have active infection and elevated levels of ESR and CRP. Range of elbow movements was full. His forearm was in full pronation allowing only 30° of fully pronated position. Initially the infected, necrosed bone segment of about 9 cm was removed along with plate. An external fixator was then applied under general anaesthesia to maintain the gap [Table/Fig-2]. It was followed up for six weeks of appropriate antibiotic therapy. He was lost in follow up for the next two months. At the second instance of presentation his x-ray through the same central previous sinus tract revealed a gap of 8 cm with loss of radial dominance at wrist. The wound was found infected and discharging pus. After initial management with debridement and antibiotics for four weeks, Nicoll's method was used to treat the patient three months following his first surgery. Nicoll's method consists of use of iliac crest graft with a modified fixation of square nail insertion through the graft to restore the length of radius [Table/Fig-3].

SURGICAL TECHNIQUE

First the forearm external fixator was removed under general anaesthesia. The surgical wound track which previously got infected was then cleared through Thompson approach with thorough debridement until the graft bed appeared red and bled freely, along

with appropriate antibiotic. The proximal and distal stump ends were cut to create raw fresh vascularized bony ends [Table/Fig-4]. Both ends were drilled retrograde with 2.7 mm drill bit to open medullary cavity. Then the bone gap was measured intra operatively to 10cm. Now the Ipsilateral iliac crest depicted in [Table/Fig-5] was exposed in normal way and an 11 cm graft as depicted in diagram was harvested. The gap created was closed meticulously with non absorbable sutures, so as to prevent herniation and a closed suction drain was placed before closing the wound in layers. Then the block of graft taken was trimmed at both ends to have long block of graft of desired ten cm length. The block was then reamed eccentrically with a 3 mm wire/3mm drill bit through and through its longitudinal axis. The drilling through the harvested bone graft was eccentric. A square nail of determined length was passed into the distal fragment of radius through lister's tubercle and as the square nail protruded out through the distal stump the pre reamed cortico-cancellous graft was threaded on to the nail [Table/Fig-6]. As soon as it protruded out through the other end of the graft the proximal fragment reduced over the nail with angulation and distraction techniques. The graft was then rotated in such a way that the natural iliac crest curvature mimics normal radial bowing. Haemostasis was achieved and wound was closed over suctioned drain in layers. Postoperatively above elbow slab was given for a period of four weeks. The patient was then allowed active finger movements and was serially followed up for six months with x-rays at two monthly intervals.

At the end of six months post operatively evidence of union was found at both ends of the graft and still the patient lost radial dominance at wrist. So he was operated again by shortening the ulna through a step cut osteotomy and plating, restoring the radial dominance. Finally, at eight months postoperatively patient was found to have acceptable forearm and hand functions [Table/Fig-7].



[Table/Fig-1]: Radiological image showing infected non union of radius that was previously fixed with plating **[Table/Fig-2]:** External fixator applied to maintain length of the radius **[Table/Fig-3]:** Modified Nicoll's method of management of infected gap union of radius **[Table/Fig-4]:** Infected segment of bone removed from radius **[Table/Fig-5]:** Depicts the length and width of graft used for reconstruction of the lost segment of the radius



[Table/Fig-6]: Diagrammatic representation of how the graft was assembled over the nail to fill the gap between the radial fragments



[Table/Fig-7]: Serial clinical images showing various stages of management of the patient

DISCUSSION

Nonunion can be caused by factors such as comminuted or segmental fractures, bone defects, interposition at the fracture site, disruption of the blood supply in the fracture fragments, inadequate stabilization and local infection [1]. Davey [2] modified Nicoll's technique and used blocks of the corticocancellous bone with a single cortex from the iliac crest, augmented with rigid plate fixation under compression. Edgardo Arrendondo Gomez [3] reported good results using an Iliac crest graft with medullary nail fixation using a hun (hunec) nail.

Surgical treatment aims to regain proper length, restore the anatomy and recover function of the forearm [4]. Nicoll described the procedure with a block of cancellous bone graft fixed at both ends with plate and screws and reinforced with cancellous slivers at both junctions. We modified this procedure by maintaining the graft with nail without any additional sliver grafts at junctions. Before insertion of the graft we ensured that both cut ends of the recipient site has good blood supply by cutting the atrophic ends until normal bone is visualized which bleeds freely.

We achieved defect filling with osteo inductive and osteo conductive graft block and internal fixation by nail imparting stability to the fracture. In our procedure removal of nail does not require re exposure of graft area. We used less metallic implant material which is advantageous over plating. We did not use any vascularized fibular bone graft which requires vascular surgery. The residual ulnar dominance at wrist was managed with step cut osteotomy of ulna rendering better wrist function.

Hong et al., [4] reported the results of 26 forearm nonunions in 15 patients treated with open reamerization, iliac bone grafting and intra medullary nails. Mean bone loss for all patients in their series was 20 (range: 10 to 30) mm. We used a similar technique of intramedullary fixation with flexible nails and iliac crest bone graft. Mean union time for the radius and ulna were 14 and 15 weeks, respectively according to Hong et al. In our patient, union was achieved in about 24 wk.

In a series with 14 patients, Krzykawski et al., [5] reported an average graft length below 5 cm. Graft incorporation and bone healing occurred between 26 and 33 wk for single-bone non unions and after the 33rd week in the forearm double-bone non unions. We used a 10 cm bone graft and achieved union in about 24 wk which is less than the average period described for union in single bone non union in this series. The authors reported that elbow and wrist functions of all patients in their series were sufficient. Our patient had good elbow function but the loss of radial dominance interfered with his wrist function. This was addressed with step cut osteotomy of ulna.

One of the important factors in achieving functional success is the restoration of radial bowing. This was well restored in our patient which helped in improving his functional ability. Plate and screw fixation is the most commonly used method for diaphyseal nonunions [6]. The IM nailing technique results in less damage to the soft tissues and vascular supply compared to open techniques. A review of the literature suggests that nonunions of the ulnar and radial diaphyseal defects of up to 6 cm can be treated with autologous cancellous bone grafts [7]. The length of bone defect was about 10cm in our patient. Though the defect was larger than the limit opted for bone grafting, the result achieved was satisfactory. The Nicoll's technique is recommended only in the absence of infection and if the bony gap does not exceed 50mm. We have modified this technique and opted to extend its use for a bone defect of more than 5 cm.

CONCLUSION

Nicoll originally described this method using a plate for fixing the graft in aseptic cases. We have modified his technique by using flexible nail for fixing the graft. Also, we have applied this method for a bone defect of 10cm which is more than what was originally proposed as the upper limit of fixation using iliac crest bone graft.

This surgical procedure has allowed early rehabilitation of our patient. Nailing has proved as a useful option in our patient. Successful outcome makes it a useful alternative to plate osteosynthesis in treatment of non unions. Though Nicoll has advocated fixation of graft with plate and screws to achieve union, we could achieve this with intramedullary nail in our case. Enthusiastic young surgeons may opt this treatment modality as the hard ware is less and removal of hardware is easy.

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