Treatment of Atrophic Tibial Non-union by Modified Judet’s Osteoperiosteal Decortication and Plating- A Retrospective Study

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BINOD BIJUKACHHE, BIGYAN BHANDARI
• Long bone fractures are the most common fractures

• one third of which involve tibia

• Tibia also happens to be the most common site of long bone nonunion with a non-union rate of 2.5%.

CAUSES

- Lack of surrounding muscles antero-medially
- Inadequate immobilization of fracture fragments
- Comminution & bone loss
- Subclinical infection
- Devascularisation of fracture fragments in open fractures

Increased incidence of nonunion in tibia.
WHY DISCUSS???

- It often entails multiple interventions over a period of months to years

- leads to functional limitation, disability

- increased financial burden both on the patient and on the society
TREATMENT METHODS:

• autologous bone graft

• extracorporeal shock wave therapy

• osteo-inductive molecules like bone morphogenetic protein (BMP) or platelet-derived growth factor (PDGF)

• ultrasound stimulation

• stimulation by electric/electromagnetic fields

APART FROM THE GOOD OLD INTRAMEDULLARY NAILING!
AIM OF THIS STUDY…….

• to describe the results of a new technique of plating of tibial nonunion after raising a single osteoperiosteal flap without bone grafting or use of any other bone healing adjuncts.

• modification of the original decortication technique described by Judet and Patel in 1962

• simple, less invasive and has given us excellent results in our center in terms of bone healing and functional outcome.
MATERIALS AND METHODOLOGY

- Retrospective study, we analyzed 35 consecutive cases of aseptic, atrophic nonunion.
- Treated by internal fixation with plating after osteoperiosteal decortication.
- By a modification of Judet’s technique during the time period January 2006 to July 2013.
- The patients were identified from medical records maintained by the operating surgeon.
- Necessary data was collected on a standardized proforma.
Criteria

• **Inclusion:**
  • All cases with clinical symptoms, abnormal mobility at fracture site with radiological an evaluation showing atrophic nonunion.

• **Exclusion:**
  • cases treated with methods other than the modified Judet’s technique (including cases in which bone grafting was performed as an independent or combined procedure with other modalities).

  • Patients with clinico-radiological features and/or blood parameters suggestive of infection.

  • Pathological fractures of tibia.
Outcome measures

- time taken to achieve union after the procedure.
- union was defined as clinical absence of pain both on palpation and weight bearing along with radiological evidence of bridging of 3 or more cortices on two perpendicular views.
  
  {non-union was defined as the absence of signs of progressive repair for an arbitrary period of 6 months following fracture.}

- Post-operatively, these patients were followed up until union was achieved or until implant removal was done.
We also investigated…….

- correlation between age of patient and time of achieving union
- time to achieve union was different among patients with open or closed fractures.
Surgical Technique

The incision was made with a sharp scalpel down to the bone, from skin to the periosteum.

A sharp chisel was used to raise about 2-3 mm thick cortical bone as one piece throughout the surface to be plated.

Care was taken not to break the cortical sleeve into pieces so that the entire tissue with part of cortical bone was raised as a single flap.

In cases where the periosteum was thin and adherent, the cortical sleeve was raised with caution and the sleeves were raised in pieces with number.
• Sleeve was raised only up to the distance, in both directions, which could easily accommodate the plate.

• The soft tissue attachment on other surface of tibia was left untouched thus preserving the vascularity.

• Freshening of the fracture margins or opening of medullary canal was not done.

• Fracture was aligned as much as possible to an acceptable anatomical position and plated in buttress mode in situ.

• This was followed by suturing the entire flap with cortical sleeve in place.

• Bone grafting was not used in any case.
- Post-operative knee and ankle range of motion exercises were started after 24-48 hours of surgery.

- Sutures were removed on 14th post-operative day.

- Post-operative thromboprophylaxis was not used in any case.

- Partial weight bearing was started at 8 weeks and full weight bearing at 12 weeks post-surgery.
STATISTICAL ANALYSIS

- Chi square tests were used for categorical data and independent samples t-tests were used for continuous data.
- Cross-tabulations were used for counts on more than one variable and frequencies for individual variables.
- Correlations between variables were also calculated.
- SPSS 21 (Software Package used for Statistical Analysis) was used for the statistical analysis.
Results

<table>
<thead>
<tr>
<th>Characteristic</th>
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<tbody>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Initial fracture type</td>
</tr>
<tr>
<td>Open</td>
</tr>
<tr>
<td>Closed Fracture</td>
</tr>
<tr>
<td>Location</td>
</tr>
<tr>
<td>Proximal third</td>
</tr>
<tr>
<td>Middle third</td>
</tr>
<tr>
<td>Distal third</td>
</tr>
<tr>
<td>Proximal and middle thirds</td>
</tr>
<tr>
<td>Distal and middle thirds</td>
</tr>
<tr>
<td>Primary etiologic cause</td>
</tr>
<tr>
<td>RTA</td>
</tr>
<tr>
<td>Stress fractures</td>
</tr>
<tr>
<td>Primary mode of management</td>
</tr>
<tr>
<td>Conservative</td>
</tr>
<tr>
<td>External fixation(EF)</td>
</tr>
<tr>
<td>Plate fixation</td>
</tr>
<tr>
<td>IM Nail fixation</td>
</tr>
<tr>
<td>EF + IM Nail</td>
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</tbody>
</table>

**Figure 3:** Pie-chart depicting the types of primary fracture treatment used.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>External fixation</td>
<td>25</td>
</tr>
<tr>
<td>IM Nail</td>
<td>3</td>
</tr>
<tr>
<td>Plating</td>
<td>4</td>
</tr>
<tr>
<td>Cast</td>
<td>1</td>
</tr>
<tr>
<td>EF + IM Nail</td>
<td>1</td>
</tr>
</tbody>
</table>

Mean time from initial surgery to decortication: 7.13 months
Mean time to fracture union after decortication procedure: 8.24 months
The mean time to achieve union was 8.24 months (SD=1.99 months; Range: 5-12 months)

Figure 4: Bar graph depicting time after which decortication procedure was done after the initial management.
• Time to achieve union was inversely proportional to the age but the result was not statistically significant (p=0.068).

• There was no correlation between time of achieving union and time since initial management to osteoperiosteal decortication or with the Gustilo-Anderson grading of the open fractures.
Discussion:

- The principle of this technique is faster healing of the nonunion, where adhesions have formed between the soft tissues and bone chips from the ununited bone itself, provided the bone is not devascularised.
- The technique is also reported to be easier in cases of delayed union where adhesions have formed between the soft tissues and bone.

CORR. NO.87; SEP. 1972

Muscle Pedicle Bone Grafting of Long Bones
by Osteoperiosteal Decortication

PR. B. JUDET AND A. PATIL

Bone grafting is the accepted method of treatment for a pseudoarthrosis following the fracture of a long bone, the bone grafts usually being taken either from the tibia or the iliac crest. We have noticed that faster and firmer healing of a pseudoarthrosis could be obtained by surrounding the fracture site with bone fragments not detached from their blood supply, and that, under these circumstances, a more abundant amount of new bone would be likely to form quicker. Our technique, muscle-pedicle decortication, uses the osteoperiosteal bone grafting, appears to produce the desired result. Before 1962, we only used compression on plate or external fixation to cure pseudoarthroses with a success of about 80 per cent.

TECHNIC

The method consists in elevating cortical chips by means of a special chisel. The chips remaining attached to the periosteum and to the musculature were surrounding the pseudoarthrosis site. This method is easy to use when adhesions have formed soft tissues between the bone and the vitality, as is the case with malunion, nonunion or delayed union. Although technically more difficult, it is possible to perform an osteoperiosteal decortication on normal bone, particularly when the area of muscular insertion are used. For example, in the femur the grafts are pediculated on the vastus lateralis, the quadriceps, the glutaei and the vastus lateralis. In the tibia the attachments of the soft tissues to its posterior and lateral surfaces facilitate this procedure. It is important to notice that, on the anterior surface, there is no cleavage between the bone and the overlying skin. Surgical separation of the structures suppresses the circulation of the periosteum. Excellent results have been obtained by detaching an even cortical chip, periosteum and the overlying skin as a single layer from the anterior tibial surface.

Muscle-periosteal decortication is always performed in the same manner regardless of the particular approach used for the lesion. The segment which is to be decorticated is approached directly. The incision must go right through the muscles and the periosteum down to the bone. The chips are detached from the superficial portion of the cortex by means of a very sharp chisel. Chips must be about 0.5 cm in width, therefore, the tip of the chisel must be almost tangent to the bone. Detaching the first chips is often difficult, it requires considerable care. The decortication becomes easier as the operation progresses. The area decorticated is usually 12 or 15 cm long and extends well beyond the malunion or nonunion (Fig. 1). As much of the circumference of the bone as possible is decorticated. At least two-thirds or three-quarters of the circumference of the bone should be exposed in this fashion. When the decortication is completed, the chips line the periosteum and the surrounding muscles. These are carefully repositioned away from the epiphysis and any further steps which may be necessary for alignment, retention of necrotic bone, internal fixation or detachment are performed (Figs. 2 and 3).

The treatment of pseudoarthrosis varies according to the particular problems of each individual case. Usually, decortication is combined with internal fixation. The screw, while adding to the stability, must not hinder the function of the grafts or otherwise damage the surrounding soft tissues. Once thousand sixty-eight decortications have been done in combination with internal fixation, using either bone plates, intramedullary rods or external skeletal fixation.

With a few stitches, the periosteum and the soft parts can be closed around the bone. The grafts are thus brought into intimate contact with the bone fragments. If possible, some of

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<table>
<thead>
<tr>
<th>Categories</th>
<th>Judet’s technique</th>
<th>Modified Judet’s technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Area of decortication</td>
<td>12-15cm long</td>
<td>Limited to area of the plate</td>
</tr>
<tr>
<td></td>
<td>2/3rd to 3/4th of bone circumference</td>
<td></td>
</tr>
<tr>
<td>2) Fracture site manipulation</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Resection and/or freshening of fracture ends performed.</td>
<td></td>
</tr>
<tr>
<td>3) Type of plating</td>
<td>Compression plating</td>
<td>Buttress plating</td>
</tr>
<tr>
<td>4) Indication</td>
<td>Septic and aseptic pseudoarthrosis</td>
<td>Aseptic nonunion only</td>
</tr>
</tbody>
</table>

Table 3: Comparison of Judet’s and modified Judet’s technique
SINCE THEN...

- only 2 major studies have explored this technique in nonunion surgery.

- Ramoutar *et al.* combined Judet’s technique with compression plating to treat long bone nonunion (both upper and lower limb long bone fractures) and concluded that routine use of bone grafts is not necessary when there is minimal or no bone loss for treatment of non-union.

- Guyver *et al.* observed that Judet’s technique with plate and screw fixation was highly effective in treating failed fracture union and was best suited for hypertrophic non-union in short oblique and transverse diaphyseal fractures which failed to unite following intramedullary nailing.
Judet osteoepiosteal decortications for trauma: The Cornwall experience

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ABSTRACT

Article history:
Accepted 31 March 2012

Keywords:
Judet
Osteoepiosteal
Decortications
Non-union
Fracture

Background: The treatment to achieve bone consolidation in 1963. He stated that by elevating tissues surrounding the site, he was able to achieve good results in the treatment of long bone non-unions. Despite excellent results published at that time, the technique has not yet become widely used. We report our technique and methods used.

Methods: Retrospective analysis of 39 patients of osteoepiosteal decortications between 1963 and 2011. All patients were reviewed after learning the technique. The technique was also used to assess its use.

Results: Union was successful in 36 patients, 4 patients failed to fuse. The technique was performed with a mean of 3.6 months (range 3–47) after fracture. No superficial infection or wound dehiscence were recorded.

Conclusions: Osteoepiosteal decortications are an effective technique to achieve bone union in refractory fractures.

Judet decortications and compression plate fixation of long bone non-unions: Is bone graft necessary?

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ABSTRACT

Non-union occurs in 5–10% of all fractures and is caused by a variety of mechanical and biological factors. Stable fixation is essential and many authors recommend the addition of bone graft. Our aim was to evaluate the results of internal fixation using Judet decortications and compression plating for long bone fractures and assess the impact of bone grafting on union rates. Our study group comprised all the patients undergoing compression plate fixation under a single surgeon over a fourteen year period (n = 96). AO principles were used and the standard technique involved Judet decortications, compression plating and lag screws. Autologous bone graft was harvested from the iliac crest. The mean age was 45 years and 62% were male. The fracture site was the clavicle (n = 20); humerus (n = 23); radius and ulna (n = 5); femur (n = 31) and tibia (n = 17). The primary fracture treatment was non-operative (n = 41); IM nail (n = 22); plate fixation (n = 28); external fixation (n = 5). Deep infection was present in 6 cases. Bone graft was used in 40 cases. 91/96 non-unions treated with compression plating healed (95%). Bone grafting was used in all cases for the initial part of the series but its use declined as the surgeon became more confident that the non-unions would heal without the use of bone graft. The case mix and complexity remained constant throughout the study period and the union rate also remained constant. The mean time to radiological union was 6.4 months. In those treated with a compression plate without bone graft the union rate was 94.6% whilst the addition of bone graft resulted in a union rate of 95% (p = 0.67). From our study we concluded that the routine use of autologous bone graft may not be necessary and, based upon the union rates observed in this study, a prospective randomised study to evaluate the use of bone graft in non-union surgery would need a sample size of 194,000 to detect a significant increase in union with 80% power. In terms of Numbers Needed Treated (NNT), we would need to give 1179 patients a bone graft to prevent one additional failure of healing.

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<table>
<thead>
<tr>
<th>Authors</th>
<th>Total no. of cases</th>
<th>No. of Tibial nonunions</th>
<th>No. of atrophic tibial non unions</th>
<th>Union rate</th>
<th>Average time to achieve union(in months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Judet et al\textsuperscript{15}</td>
<td>849</td>
<td>416</td>
<td>Not mentioned</td>
<td>94.83%</td>
<td>4-8</td>
</tr>
<tr>
<td>Ramoutar et al\textsuperscript{19}</td>
<td>96</td>
<td>17</td>
<td>Not mentioned</td>
<td>100% (with decortication) 86% (when bone graft used)</td>
<td>6.4</td>
</tr>
<tr>
<td>Guyver et al\textsuperscript{20}</td>
<td>40</td>
<td>10</td>
<td>Both hypertrophic and atrophic</td>
<td>90% (For nonunion 8 tibia individually)</td>
<td></td>
</tr>
<tr>
<td>Our study</td>
<td>35</td>
<td>35</td>
<td>Atrophic only</td>
<td>100%</td>
<td>8.24</td>
</tr>
</tbody>
</table>

Table 4: Comparison of results of studies in which Judet’s osteoperiosteal decortication technique has been used in tibia non-union (including our study results).
Case 1
32yrs/M
4 months

Ring removal
LLC
6.5 months
1 year F/U

Pre-op

1 year f/u: Union achieved
Case II
28yrs,m

RTA with GIIIb segmental comminution fx
Following External fixator application and Debridement
Osteoperiosteal graft
Implant removal
CASE4
LIMITATIONS OF THE STUDY....

- include factors which are inherent to any retrospective, nonrandomised study wherein the chance of patient selection bias cannot be totally ruled out.
- There was a lack of control group to compare results of decortication with other augmentation procedures like bone grafting.
- Sample size is small but taking into account that the study focused exclusively on atrophic type of aseptic tibial nonunion, this makes it the largest case series of its kind till date.
- In the future, randomised comparative trials or cohort studies in larger populations will be needed to ascertain the results of this osteoperiosteal decortication technique.
- The method is also not useful for gap non-unions
- sometimes not feasible in the metaphyseal proximal and distal tibial fractures due to condition of the overlying soft tissue and difficulty in achieving coverage for plate.
WHY USE THIS METHOD??…

• modification of Judet’s osteoperiosteal decortication is a safe and effective technique in the surgical management of nonunion tibia.

• Routine use of autologous bone graft is not needed in all cases of nonunion tibia.

• It is also a cheaper alternative to other bone healing augmentation procedures like BMP, EMF stimulation, extracorporeal shockwave therapy etc. especially in poor, developing countries.

• The procedure is simple and easily reproducible in most hospital settings with access to appropriate instruments.
QUESTIONS??

PlayStation 2

WWF SMACKDOWN! JUST BRING IT

THQ

THANK YOU