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Autologous drill dust bone graft a novel technique of bone graft harvesting

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Abstract
This paper, describes a novel technique of graft harvest from the drill site during plate osteosynthesis of fractures of upper limb. The grafts harvested are corticocancellous chips which we prefer to name as 'Drill dust'. This drill dust usually goes wasted as surgeons tend to ignore to collect the drilled out bone which is usually washed out during or after the procedure. We decided to collect these drilled out bone in a meticulous and systematic manner and found that they form a significant amount of bone to be used as a graft at the fracture site which can potentially enhance fracture union. We did a study utilising our technique assessing clinical and radiological union in a subset of patients undergoing upper limb fracture plate osteosynthesis between July 2018 to Jun 2019. We found that there was an enhanced radiological and clinical union in all 28 of our cases where this technique was used. There were no complications noted with the procedure.

Keywords: Autologous bonegraft, drill dust, plate Osteoplus synthesis.

Introduction
Autologous bone graft plays a main stay in orthopaedics with its various applications in enhancing fracture union, filling a bone defect, etc. Most common autologous bone graft harvest site is iliac crest with less common sites being proximal and distal tibia, distal radius, olecranon and greater trochanter. Autogenous cancellous bone graft, with its osteogenic, osteoinductive, and osteoconductive properties, remains the gold standard for grafting. The Merits of This autogenous grafting comes with demerits of the high incidence of morbidity during graft harvest. The most important of them involves a second incision on a different site, increase in pain and bleeding, chances of infection, hematoma, fracture, nerve injury etc.
We hereby propose a different method of procuring autograft which reduces or nullifies most of the demerits but offer most of the qualities of the autogenous bone graft at the same time. This novel technique of graft harvest from the drill site during plate osteosynthesis of fractures.

Materials and Methods
This is a prospective descriptive study involving 41 cases of upper limb traumatic fractures undergoing plate osteosynthesis between July 2018 to Jun 2019. We lost 13 cases during the study period and remaining 28 was considered for the study.
Electric powered drills were used for the surgeries immediately after putting each drill hole the bone dust was collected in a sterile bowl using a curette and forceps.
And this bone dust was used as bone grafts for the augmentation of union of fractures. Majority of the cases were followed up till clinical and radiological union happened or three months whichever is later.

Results
We found that there was an enhanced radiological and clinical union in all 28 of our cases where this technique was used. There were no complications noted with the procedure.

Description

All the surgeries were in the upper extremity. Electric powered drills were used for the surgeries. In order to control the heat and associated necrosis of the bone dust the drills were used at Ream mode at 270 RPM. One cortex was drilled first and then bone dust is removed and drill bit was cooled in saline before drilling the second cortex. Bone dust was collected in a sterile bowl using a curette and forceps.

Fig 1: Intro op picture of collection of bone graft

Fig 2: Collected bone graft in a bowl

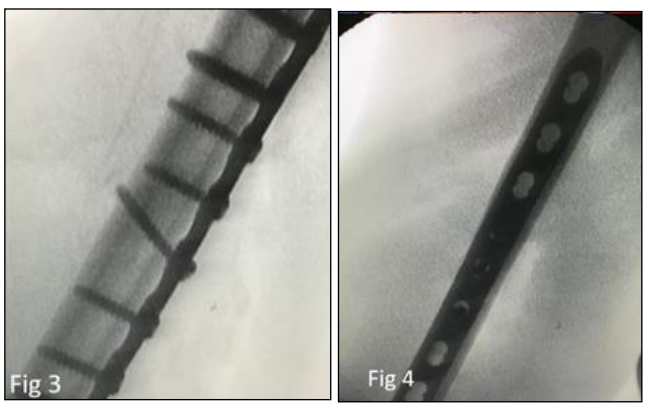

Fig 3 & 4: Intro op image intensifier images

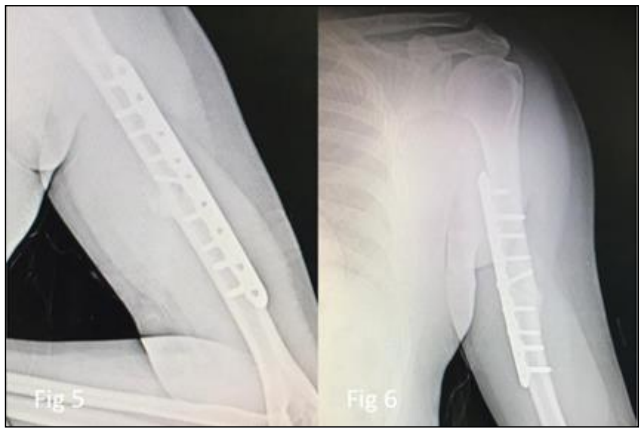

Fig 5 & 6: X-rays after 3 month

The collection bowl was covered with a sterile gauze dipped in normal saline. After fixing the planned number of screws in the plate the fracture gaps are filled with the bone dust. On an average 6-8 drill holes gave 2-3 cc bone dust. In those cases where there is no gap between the bone fragments the secured bone dust is deposited near the fracture for bone induction and the rest of the sample is sent for histopathology for histological evidence of healthy osteocytes.

Rationale

Drill dust is an abundant source of autogenous bone graft that give us provisions for filling the bone defects and also give better osteoinduction leading to better union. Conventional techniques of open reduction and internal fixation of fractures have not utilised this possibility which resulted in the discarding of a precious resource that could have been a solution to bone graft resources**.**

Need for the study

Despite the recent advances and prolonged research we are yet to find out an ideal bone graft. The autograft from the patient themselves is considered to be the gold standard. But even then this comes up with some limitations of an added morbidity to the individual. The novel technique of autograft collection literally abolishes most of the demerits. It also yields highly decorated autograft without any additional expenses, instrumentation and effort. Hence proving the effectiveness of this technique will benefit patients all around the globe.

Indications & Contraindications

Indications: Adult upper extremity fractures who were able to give written informed consent.

Contraindications

- Infected fractures.
- Compound fractures.
- Fractures with significant bone loss warranting strut cortical graft.
- Paediatric fracture.
- Patients who were unable to give written informed consent.

Results

Out of all 41 subjects28 were followed up on a fortnightly basis x-ray radiographs of the affected extremity till the completion of third month or till complete union of fracture whichever is later. 13 cases we lost for follow up. The average follow up period was 15 weeks.

We found that there was an enhanced radiological and clinical union in all 28 cases where this technique was used. There were no complications noted with the procedure. 13 of these fractures were simple fractures.4 of them had a butterfly fragment. 11 fractures had commination at the fracture site. Primary bone healing with the re-establishment of the cortex without the formation of a callus was observed in 10 cases of simple fractures (76.9%) and 2 (50%) of the butterfly pattern fractures. Enhanced callus formation (secondary bone union) were observed in all 11 communited fracture fragments and 2(50%) butterfly fragments and 3 cases of simple fracture (23.1%).

History of Bone Grafting

Evidence of bone grafting has been found in the skeletal remains of prehistoric peoples, like Egyptians, Khurits, and Aztecs [1]. Autologous bone grafting have stood the test of time for centuries and remains in common use today [2]. The first documented bone graft was by Jacob van Meekeren which was a xenograft from a dog calvarium to a soldier's skull [3]. First human allograft bone transplant was done by William MacEwen in 1879 [4]. Even after centuries of research and discovery of many bone substituents bone remains the second most common tissue transplanted, with over 2.2 million bone graft procedures now performed per year world-wide [5]. But many surgeons are hesitating to do allograft bone grafts due to its potential for disease transmission and immunogenic reactions tendencies.

Drawbacks of the study

We might have overlooked the effect of the bone grafting those cases where there was no indication to for bone grafting or where primary bone healing could have taken place without any interventions. Also the need for structural bone grafting cannot be replaced by this technique. An associated increase in time could be considered against the benefits of the procedure due to slow drilling, meticulous collection technique and final bone grafting.

Conclusion

Bone dust grafting is a priceless source of bone auto graft without any demerits of a regular bone graft. Enhanced union and callus formation is noted in cases with bone dust graft usage. Further study on the bone dust graft technique can provide a better solution in fracture management.

Conflict of Interest

Not available

Financial Support

Not available

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