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Fracture Healing After Closed Intramedullary Nailing For Tibial Fractures In Diabetes Mellitus Patients And Non Diabetes Mellitus Patients –A Comparative Study

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Abstract:
Background: *Previous studies have shown an increase in complications in diabetic patients undergoing orthopaedic procedures, but there is limited information in relation to the outcome following the operative treatment of diaphyseal fractures of the tibia in the diabetic patients. So this study is done to assess the difference of fracture healing at clinically.*
Method: *The tibial fracture that are reduced and treated with closed intramedullary nail are evaluated for fracture healing. The 2 groups with diabetes mellitus and without diabetes mellitus. The fracture healing is assessed by bridging of 3 out of 4 cortices across the fracture site in antero posterior and lateral X- rays. And the time taken for it is measured. This is compared between the groups. And the complications are also recorded.*
Results: *In the 48 samples , 27 were non diabetic and 21 were diabetic. There were 11 openfractures.When we compare the closed fractures in diabetes group and non diabetes group, 7 out of 16 (43.7%) cases healed within 6 months in diabetes group and 10 out of 21(47.6%) cases healed within 6 months in non diabetes group (p value = 0.713).*
Conclusion: *There was no statisticalsignificance between the healing times in diabetes group and non diabetes group. Due to the lack of adequate samples the result is inconclusive.*
Key Words: *Fracture; Healing; Diabetes; Intramedullary nailing*

I. Background Of The Problem

An understanding of the diagnosis and treatment of tibial shaft fractures is of importance to primary care physicians and orthopaedic surgeons alike. The number of vehicle accidents on the rise, trauma cases reaching the emergency department has increased. Being subcutaneous in location Tibia is one of the common bone to be fractured. Often, the primary care provider first comes into contact with tibial shaft fractures and must make the diagnosis and early treatment decisions. The major goal in treatment of the fractures is achieving functionally useful and stable extremity. Tibial shaft fractures is associated with various complications like infection, delayed union, non union. As tibia is subcutaneous bone, the occurrence of open fractures of tibia is common. Hence chances of infection and multiple surgeries are more in tibia fractures.

Tibia shaft fractures are treated by interlocking intramedullary nailing. Fracture healing is a process that depends on many factors. Diabetes mellitus is a systemic condition that can have effect over the fracture healing. So this study is done to assess the difference of fracture healing at clinically. Also to know the impact of diabetes over the possible complications of tibia nailing. Previous studies have shown an increase in complications in diabetic patients undergoing orthopaedic procedures, but there is limited information in relation to the outcome following the operative treatment of diaphyseal fractures of the tibia in the diabetic patients. This study evaluated the outcome of fractures of the tibia treated with reamed intramedullary nailing technique in diabetic patients compared to non diabetic patients with the same technique.

II. Review Of Literature

Studies have reported delayed union or increased healing time in diabetic subjects compared with matched controls[1-3]. Diabetes impairs fracture healing of bone, including the mandible, hip, and long bones[4,5-7].

Streptozotocin- induced diabetic animals also exhibit changes in long bones consistent with impaired healing, including smaller calluses with decreased bone and reduced mechanical strength compared with those of controls[8-10].The phenomenon where deficits in fracture repair are corrected by with insulin suggests that the reason of diabetes and not an adverse effect of streptozotocin on bone[10,11]. Diabetic animals also exhibit reduced strength in healed fractures , finding supported by delayed recovery of structural and material strength by at least 1 week in the healing femurs of diabetic rats when compared with those of normoglycemic

controls[12].

Approximately 20% decrease in biomechanical strength in femurs and tibias was reported in the animal models[13,14]. Bone formation is also decreased in diabetes, which may be an important reason for impaired fracture healing[15-18]. Diabetes is also accompanied Decreased in osteocalcin levels is seen in diabetes which is a marker of bone formation[19]. Serum alkaline phosphatase (ALP) and osteocalcin levels were significantly lower in type 1 diabetes than those of the control subjects, suggesting reduced bone formation .Osteoblasts are also affected by diabetes. Another study by Follak N & et al revealed decreased mineralization, apposition, and timing of mineralization in diabetic rats with poor glucose control[20]. Hyperglycemia can produce insulin resistance of osteoblasts, which might affect transport and function of glucose transporter 1[21].Advanced glycation end products may cause inhibition of osteoblast function and reduced bone formation [22].Relative absence of insulin rather than the hyperglycaemia may contribute to alterations in bone caused by diabetes[23,24].

The transition from cartilage to bone can be affected by diabetes thus causing impaired fracture healing. Topping et al study has shown 54-70% decrease in Type X collagen in the fracture callus of diabetic rats and suggested that this might have a role in defective diabetic fracture healing[25].It is proposed that insulin has an anabolic role in bone[26,27].Aderinto& et al [28] reviewed 27 diabetic patients who sustained a tibial fracture treated with a reamed intramedullary nail and compared them with a control group who did not have diabetes.There was no significant difference in the rate of complications between the diabetic patients and the control group. There was a tendency for more severe infections in patients with diabetes.

Krakauer et al [29] have suggested that diabetic patients have reduced bone formation and accumulation during growth.Later in life, hyperglycaemia leads to increased bone resorption and osteopenia.

III. Materials And Methods

Study Design

Prospective case study.

Place of Study

Jubilee mission medical college & research institute, Thrissur 680005

Study Population

1) Patients (both male and female) aged 20 years or older

Duration of study : One and half years

InclusionCriteria

1) Skeletally mature.

2) Tibial shaft fracture amenable to treatment by intramedullary nailing.

Exclusion Criteria

1) Pathologic fractures secondary to neoplasm.

2) Fracture with vascular injury requiring repair.

3) Known metabolic disease except Diabetes mellitus

4) Open fractures unable to undergo debridement and irrigation in the first 24 hours.

5) Retained hardware or existing deformity in the affected limb

6) Surgical delay greater than 3 weeks for closed fractures or 24 hours for open fracture.

7) Contralateral tibial shaft fracture (bilateral injury) or lower extremity injury that would compromise outcome assessment.

8) Immunocompromised.

9) Unable to comply with postoperative rehabilitation protocols or instructions (i.e. head injured or mentally impaired).

All patients, and/or family member, are expected to sign the informed consent form before participating in the study.

IV. Results

We had a total of 51 patients in our the study. Three patients were lost to follow up. A total of 48 patients data were considered for data preparation of which

21 patients were in the diabetic group and remaining 27 patients were in the nondiabetic group. In Aderinto& et al [44] study they studied 27 diabetic patients and compared them to a control group without diabetes mellitus. The average age in non diabetes group is 32.4 years and average age in diabetes group is 54.7 The number of males in diabetic group are 16 and number of females are 5. The number of males are 16 in non diabetes group and 9 females. There were 10 fractures in the right side and 11 fractures in the left side. The number of fractures in the right side in non diabetes group is 15 and 12 is on the left side.

There were 5 open fractures and 16 closed fractures in the diabetes group. Out of which three were type 3B and two were type 2 (Gustilo Anderson Classification)[30,31]. All were managed with the same operative protocol. Two underwent secondary soft tissue coverage procedure. The fracture healing time was better in the closed fracture group compared to the open fracture group. Patients with closed fractures which required open reduction were included in the open fractures group. The number of open fractures are 6 and closed fractures are 21 in the non diabetes group. Out of which three type 2 and two were type 3B. Of these three patients underwent secondary soft tissue coverage. Healing time was better in the closed fracture group.The number of communited fractures in the diabetes group were 9 and non commented fractures were 12. All patients underwent similar surgical procedures where reamed intramedullary interlocking nailing was done in

allcases.The number of communited fractures were 19 and 8 non communited fractures in the non diabetes group. Although the amount of comminution had an effect on the healing time, there was no difference on the average healing times of the diabetic and the non-diabetic group pertaining to the amount of comminution.The fracture site in diabetes group 1 in proximal third, 6 in the middle third and 14 in the distal third. All the proximal third and the distal third fractures were 7 cm from the fracture site.The proximal third fracture healed within in 6 months. Three of the middle third fracturies healed within 6 months. Four of the distal third fractures got healed within 6 months.The fracture site in the non diabetes group 3 in the proximal third ,14 in the middle third and 10 in the distal third. Two proximal third fractures healed within 6 months. Ten middle third fractures healed within 6 months. One distal third fracture healed within 6 months. Although the healing time was better in the non diabetic group for distal one third fractures, the healing time was better in the middle one third fractures in the diabetic group.n closed fractures seven out of sixteen healed within in 6 months(43.7%). In open fractures one out of five healed within 6 months.In closed fractures ten out of twenty one healed within 6 months. Three out of six open fractures healed within 6 months. When we compare the closed fractures in diabetes group and non diabetes group , 7 out of 16 (43.7%) cases healed within 6 months in diabetes group and 10 out of 21(47.6%) cases healed within 6 months in non diabetes group (p value = 0.713 ; Fisher's Exact test).

In diabetic patients the combination of vascular compromise and peripheral neuropathy increases the risk of complications. In addition, at the cellular level, diabetic patients are prone to deficiencies in the production of growth factor, angiogenic response and macrophage function, which result in impairment of wound healing and an increased risk of skin ulceration. Following trauma to the lower limb it is important to establish whether there is evidence of peripheral neuropathy or vascular compromise. Vascularity can be assessed clinically by examining for pedal pulses and checking the capillary refill. Objective methods of assessment include the ankle brachial pressure index 24 which has a normal range from 0.9 to 1.3, although this may be falsely high in diabetic patients owing to calcification of the walls of the arteries. Peripheral neuropathy results in impairment of motor, sensory and autonomic function which can lead to muscle atrophy and loss of protective sensation. Autonomic sympathetic dysfunction results in vasodilation in the skin, with"49 reduced sweating producing increased warmth and dryness of the skin that increases the risk of breakdown. Clinical assessment of light touch, pinprick and vibration sensation can provide useful information about the extent of somatosensory impairment. There were only 2 patients had diabetic peripheral neuropathy. The non diabetic group did not contain any one with peripheral neuropathy. All the patients had distal intact pulse in the lower limb. Hence it was not possible to establish whether the presence of peripheral neuropathy or vascular insufficiency was related to any of the outcome measures. Diabetic comorbidity, such as peripheral neuropathy and microvascular disease, and the diabetes itself, may be the cause of the increased risk of complications. There was no statistically significant difference between the healing times in diabetes group and non diabetes group.

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