COMPARATIVE STUDY OF BONE HEALING FOLLOWING BONE CUTS USING SURGICAL BURS AND MICROSAWS

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ABSTRACT

Bone cuts on the tibia of 6 healthy dogs were studied using surgical burs and microsaws arranged in two groups by random selection to assess the speed of cutting, precision and bone healing. Bone cuts in Group A were made with surgical burs of 1.6 mm diameter using micromotor at 40,000 revolutions per minute (RPM) whereas in Group B they were created using Stryker microsaws of 0.75 mm width at the speed of 40,000 RPM. In each group, the dogs were sacrificed at the end of 8, 12 and 16 weeks and a section of the tibia containing the fracture site was removed to assess healing histopathologically. Based on clinical, radiological and histopathological examination, the results of this study indicate that microsaws have their best use in osteotomy procedures in terms of precision and thermal injury to bone whereas osteotomy procedures are more convenient with surgical burs.

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KEYWORDS : Bone cuts; Bone healing; Microsaws; Surgical burs.

Introduction

One of the most essential procedures in oral and maxillofacial surgery is cutting of bone, be it a part of surgical extraction, treatment of trauma, removal of cysts and tumours or orthognathic surgery. The biological aspect of bone cutting has been the subject of various studies ever since Kurt Thoma in his observations maintained that fast drilling generated heat that causes aseptic necrosis of bone [1].

Each of the cutting devices used have their advantages and disadvantages. With a wide variety of cutting contrivances the choice essentially depends on factors like speed and precision of cutting, and the reparative response of bone. The present study was undertaken with the aim of comparing the bone cuts created by surgical burs of micromotors and microsaws.

Material and Methods

This study was performed on the tibia of dogs. Prior permission of the ethical committee, Armed Forces Medical College, Pune, was obtained to carry out the study. Six healthy pariah dogs of random weight and age were chosen. They were allotted randomly to 2 groups, Group A and B, of 3 dogs each. In Group A the cutting device was micromotor with surgical burs of 1.6 mm diameter with a speed of 40,000 RPM whereas in Group B Stryker microsaws of 0.75 mm width having a speed of 40,000 RPM were used.

The dogs were initially placed in quarantine for 15 days to preclude the possibility of having acquired an infection.

The study was divided into two phases. In the first phase, fractures were created in the proximal end of tibia using burs or saws. All the other parameters including the operator, procedure, method of immobilisation were the same in both

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TABLE I

Comparative evaluation of the clinical and radiological parameters using burs and saws

Parameters	8 weeks		12 weeks		16 weeks	
	Bur	Saw	Bur	Saw	Bur	Saw
Soft tissue swelling	Moderate	Minimal	Moderate	Mild	Minimal	Absent
Mobility of fragments	Absent	Absent	Absent	Absent	Absent	Absent
Residual deformity	Nil	Nil	Nil	Nil	Nil	Nil
Callus formation	Severe	Minimal	Diminished	Absent	Absent	Absent
Periosteal reaction	Moderate	Nil	Mild	Nil	Mild	Nil
Radiological union	In progress	In progress	Complete	Complete	Complete	Complete
Areas of osteolysis	Absent	Absent	Absent	Absent	Absent	Absent

the groups. The dogs were premedicated with 50 mg chlorpromazine and 30 mg pentazocine intramuscularly 30 minutes before surgery. The dogs were then anaesthetized with 0.5 g sodium pentothal intravenously. The operative site was scrubbed and draped. A 5 cm vertical incision was made over the proximal end of the tibia. After dissecting the skin, fascia, and muscle, the tibia was exposed subperiosteally. With the bone held on either side with bone holding forceps, a surgical fracture was created under a constant stream of saline. The site was immobilised with monocortical miniplates. Hemostasis was achieved and 500 mg ampicillin powder was placed in the operative site before closure of the wound in layers. An external pressure bandage was given.

In the second phase, postoperative healing was evaluated clinically and radiologically. In each group, dogs were sacrificed at the end of 8, 12 and 16 weeks using an overdose of intravenous sodium pentothal. The fracture site was exposed and a section of the tibia containing the fracture site was removed and submitted for histopathological examination to assess healing.

Results

Evaluation of restoration of function of the limb revealed that full function in dogs subjected to saw cuts occurred in 19 days whereas in those subjected to bur cuts, it took 23 days. Clinically, in dogs subjected to saw cuts, it was observed that there was moderate soft tissue swelling at 8 weeks which continued till the 12th week and by 16th week it was minimal. This was accompanied by severe callus formation at 8 weeks which gradually diminished, and by 16th week no callus could

be observed. In dogs subjected to saw cuts, there was minimal swelling and callus formation at 8 weeks which was absent at 16 weeks (Table 1). There was no mobility of the fragments or residual deformity on manipulation in both the groups during the observation period.

Progressive radiological evaluation of bur cuts revealed moderate callus formation with soft tissue swelling over a period of time, with radiological union completed by 12th week as compared to the saw cuts which showed mild callus formation and soft tissue swelling with no periosteal reaction by 8th week. Here also the radiological union was evident by 12th week. There were no areas of osteolysis in either the bur cut or saw cut specimens (Table 1).

The histopathological picture was different with the use of the two different cutting devices. The saw cuts revealed a mature, lamellar mineralised bone while the bur cuts had an imperfectly formed bone with scanty mineralisation.

Discussion

The evaluation of bone repair following osteotomy using microsaws and surgical burs was performed clinically, radiologically and histopathologically. The texture of human bone varies from site to site. It was not feasible to use human bone in this study due to the need for histopathological evaluation of the osteotomy site. The tibia of the dog was chosen for the study as its clinical texture and thickness appears similarly to the mandible and it is technically possible to approach the bone. Boyne [2] in his study has shown that the femoral and other long bones show a similar repair response as the mandible. It was

observed that the repair following saw cuts was earlier than bur cuts, as evidenced clinically. This may not be significant statistically due to the small sample included in this study. The other parameters like soft tissue swelling and callus formation showed less intensity with use of the saws. Considering the fact that both types of osteotomy cuts were immobilised using similar type of monocortical plates, the difference in the clinical parameters is notable. While the radiological findings showed callus formation and union in progress in both types of bone cuts, the time taken for radiological union was less and the amount of callus minimal in the saw cuts as compared to bur cuts. Another pertinent feature of the saw cuts was the minimal amount of bridging callus which is in conformity with the findings of Rahn [3] who noted that in saw cuts the bones were in juxtaposition hence there was hardly any bridging callus seen in such conditions.

The histopathological examination revealed that saw cuts showed mature lamellar mineralized bone while the bur cuts had an imperfectly formed bone with scanty mineralization.

Various factors can be cited that could be the reason for the better response of bone to the saw cuts. Speed has a definite role in producing an altered response of bone repair. This has been established by various studies [2,4,5]. In an effort to exclude this factor both the cutting devices were operated at the speed of 40,000 RPM. Refels [6] established the relation of drilling time to the heat generated and its speed. In this study, it took 45 seconds to create an osteotomy cut with the saws while it took 65 seconds with the burs. This additional time could be a factor, considering the effect of drilling time on thermal changes in the bone. Another consideration is the cutting edge width of the cutting device. The saws with a cutting edge of 0.75 mm thickness had a definite advantage in the precision and fineness of bone cut as compared to the surgical bur with a thickness of 1.6 mm.

The amount of heat generated in the region of bone cut was also crucial in bone repair. There was less intense thermal change with saw cuts vis-a-vis bur cuts. Schmidt [7] showed that temperature rise was mainly related to formation of bone chips during cutting and their retention in the area

thus clogging the bur.

The micro-saw system has the advantage that it does not require oiling as in the case of micromotors. With this factor, the possibility of contamination of the surgical field with oil does not arise with the micro-saw system. All these factors support the contention that bone repair is better after the use of micro-saws than with surgical burs in terms of clinical, radiological and histopathological healing process. Notwithstanding this fact, it must be stressed that both types of cutting devices have their role in different aspects of oral and maxillofacial surgery. The anatomical diversity of the region precludes the use of a single type of instrument for all procedures.

Based on clinical, radiological and histopathological evaluation, the results of this study seem to justify the choice of micro-saws as a suitable device in oral and maxillofacial surgery in areas where these can be used and where they have a definite advantage over surgical burs in terms of precision and thermal injury to bone. The micro-saws have their best use in osteotomy procedures, where minimal bone removal is mandatory during the procedure. The osteotomy procedures in contrast are more convenient with the surgical burs. The design of saws also inhibit their use in certain anatomical situations and in procedures like surgical extractions where the burs have become the mainstay in bone cutting procedures.

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