Abstract

This study was approved by IACUC Yale. (Protocol number 11-11393).

Methods

Surgical procedure

Three New Zealand rabbits (2 treatment and 1 control) were used. A subperiosteal scalp flap was raised and critical-sized defect created (16x16mm) using a piezo saw (Synthes). Dura was left intact. In treatment animals, a transport segment was created contiguous to the defect and device attached (Fig. 1 and 2).

Distraction protocol

After one-day of latency, animals were distracted at 1.5mm/day for 13-15 days. Animals were sacrificed at 5 weeks consolidation.

Micro CT

Specimens were scanned by micro CT (in vivo CT-120, GE Healthcare Inc). 50um slice thickness, 32mA, 80kV) and analyzed with Osirix. New bone volume and bone density were measured.

Histology

Heads were prepared following device removal. Specimens were fixed by buffered formalin, washed (PBS), then decalcified by 4% EDTA (4 weeks) and embedded in Paraffin. Coronal (anteriorly) and sagittal (posteriorly) sections were stained with Hematoxlin and Eosin (HE).

Results

All rabbits tolerated the surgical procedure and post surgical distraction period without complication.

Gross inspection.

Device fixation and ossified regenerate were seen in all treatment animals. In R1 and 2, the transport segment was obliquely inclined and distracted 2/3 of the track distance. Rabbits R3 and 4, showed a level transport piece with full distraction.

Micro CT

Bone density measured >10.5% (range 7.8-12.4%) in the distracted group versus 1% in the control (range 0.5-1.2%) (Fig. 3).

Histology

Trabeculae of new bone were seen in all treatment samples, in the region of the critical defect. Trabeculae were largely immature with large narrow spaces and covered with a highly vascularized, thick dura.

Conclusions

We demonstrate effective reconstruction of critical-sized rabbit calvarial defects using a novel transport distraction device.

References