

Generation of open metatarsal fracture in rats: a model for secondary fracture healing

ABSTRACT

A fracture model in rats for the study of secondary bone healing was described. Standard open midshaft transverse metatarsal fracture was produced with bone cutting forceps in 28 rats. The commonly open and close fracture models utilized for bone and mineral researches are associated with varying degree of complications ranging from a high degree of fracture comminution to severe associated soft tissue injury which interferes with the healing process. We hypothesized that fracture model in rat third metatarsal bone could be associated with low -post-surgical complications and could be a reproducible model. To test this, open mid-shaft transverse fractures were created on the metatarsals of 28 rats. The objectives of the study were to evaluate the fracture complications, to determine the nature of fracture produced, evaluate the fracture consolidation during healing periods, and to assess the histological and radiographic healing of the fracture. The fracture produced in the mid metatarsal shaft of all rats was 100% transverse, 73% located at the midshaft. Minimal fracture angulations were recorded ($0.48 \pm 0.09^\circ$; $0.78 \pm 0.17^\circ$) for anterior-posterior and lateral views respectively. Minimal soft tissue injury was recorded immediately post-surgery, but no infection and the delayed union was observed. Varying degrees of weight-bearing lameness was also recorded but seized at day six onward post-operative. Callus index observed was peaked at week 2 and 3 (2.02 ± 0.1 , 1.99 ± 0.13) respectively but declined to 1.10 ± 0.04 at week 7 during the consolidation period. The fracture line disappeared completely at week 7. The histological and radiographic healing scores were (3.5 ± 0.13 and 3.75 ± 0.25) respectively (out of the maximum healing score of 4) at week 7 post-operative. There was a positive correlation between the histological and radiographic healing scores. The metatarsal fracture model is considered to be a suitable model for in vivo study of secondary fracture healing.

Keyword: Fracture model; Rat; Fracture healing; Metatarsal