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# Successful utilization of triphasic silica containing ceramic coated hydroxyapatite (HASi) for the treatment of comminuted tibial fracture in a goat: a case report

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## Abstract

*A one year old female Sirohi crossbred goat was presented with a history of non weight bearing lameness on right hind limb. Radiography revealed comminuted fracture of tibial mid diaphysis. The comminuted fracture fragments and bone devoid of any soft tissue were surgically removed and the resultant segmental defect was reinstated with triphasic silica containing ceramic coated hydroxyapatite (HASi) after stabilising the fracture fragments with 2.7mm dynamic compression plate and screws. The animal recovered with normal limb ambulation after the eighth post-operative week.*

**Keywords:** *Comminuted, segmental defect, scaffold, HASi*

Goats are one of the major livestock reared in Southern India, especially in Kerala where both male and female goats have equal value. Lameness is considered as the third largest cause for economic loss for farmers. It reduced the resale value of goats while slaughtering and reduced breeding efficiency of bucks.

Comminuted fractures are difficult to treat because of loose bone fragments which make it difficult for anatomical reconstruction of the fractured fragments (Houlton and Dunning, 2005).

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Removal of such fragments resulted in large sized defects which lead to the formation of non unions or delayed unions.

Emara *et al.* (2015) stated that autogenous bone grafts are the gold standard and the choice of treatment of segmental defects. The major drawbacks of these grafts are donor site morbidity and unavailability of sufficient graft material. Allografts and xenografts are remedy for the drawbacks of autograft, but graft rejection and transmission of other diseases are the major disadvantages. Introduction of biodegradable synthetic bone substitute has revolutionized the scenario of treating the segmental defects.

Ceramic-based bone substitutes are reported to be the best biologically accepted materials applied to bone healing (Nascimento, *et al.* 2007). Hydroxyapatite (HA) ceramics are commonly used bone grafts owing to its osteo-conductivity and biocompatibility.

However, the disadvantage of plain hydroxyapatite is its slow rate of biological interaction. Addition of silicon (Si) with HA was found to increase the speed and quality of bone repair process. Based on these traits, a novel graft composite with porosity has been developed by incorporating tri-phasic silica containing ceramic-coated hydroxyapatite (HASi) scaffold. The porosity of the material aids in the osteogenesis through the pores and facilitate faster bone healing.

This paper describes the successful use of triphasic silica containing ceramic coated hydroxyapatite for the treatment of comminuted tibial fracture in a goat and post surgical observations over a period of eight weeks.

A one year old female Sirohi crossbred goat weighing 21kg was presented to the Department of Veterinary Surgery and Radiology, Teaching Veterinary Clinical Complex (TVCC), College of Veterinary and Animal Sciences, Pookode, Wayanad, Kerala with a history of the goat falling from a height and being lame on the right hind limb. On further examination, the goat was exhibiting non-weight bearing lameness of the right hind limb. On physical examination of the affected limb, pain and crepitus could be felt over the mid-diaphyseal tibial region.

All physiological parameters were within normal range.

Radiography with orthogonal views revealed a comminuted mid-diaphyseal fracture of the tibia along with short splinters (Figure 1 and 2).

Corrective surgery using the biomaterial graft was resorted to. The animal was premedicated with Meloxicam @ 0.2 mg/Kg body weight subcutaneously followed by Nalbuphine @ 1mg/Kg body weight and Xylazine @ 0.05mg/Kg body weight intravenously. Anaesthesia was induced by administering Midazolam @ 0.2mg/Kg body weight and Ketamine @ 5mg/Kg body weight

**Figure 1:** Preoperative radiograph showing a mid-diaphyseal comminuted fracture of tibia (Lateral view)

**Figure 2:** Cranio-caudal view

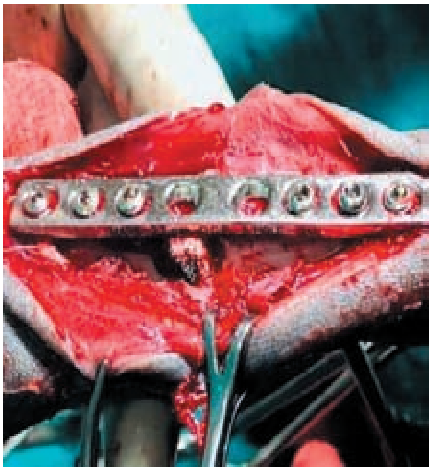

**Figure 2:** Biograft material filled into the fracture gap after fracture fixation with plates and screws.

**Figure 3:** Immediate post operative radiograph.

intravenously. Anaesthesia was maintained by giving ketamine-midazolam top-up at 1:1 (v/v) ratio, whenever required.

The tibia was approached through a cranio-medial incision. The peroneus tertius muscle, long digital extensor muscle and tibialis cranialis muscle were surgically separated and undermined to reach the fracture site. The splinters devoid of soft tissue attachment were removed from the site and fracture ends were surgically debrided. The resultant segmental defect was reinstated with bioceramic graft material HASi (Figure 2) after application of a 2.7mm 8 hole dynamic compression plate in buttress mode to stabilize the fracture fragments.

Muscles and sub-cutaneous tissue were sutured using suture material PGA of size 0 in a continuous suture pattern and skin was sutured in horizontal mattress pattern by using nylon. Modified Robert Jones bandage was applied for external immobilisation for a period of eight weeks.

Immediate post-operative radiographs showed a good apposition, alignment and no angulation (*i.e.*, the fracture fragments remained intact by the apparatus and showed no deviation from their position) between the fracture fragments, biomaterial graft and the implant (Figure 3).

**Figure 4:** Radiograph at the end of 8$^{th}$ post operative week.

Partial weight bearing was observed on the affected limb on the fourth week of observation. There was complete weight bearing and improvement in lameness by the end of 8$^{th}$ week observation (Kaler *et al*. 2009). Normal limb ambulation was regained by the animal over the next four weeks.

Radiographs were evaluated and observed on the 2$^{nd}$, 4$^{th}$, 6$^{th}$ and 8$^{th}$ post-operative weeks which are as follows:

Fourth and sixth week radiography revealed a mild degree of osteolytic activity (Nair *et al.* 2009). This was indicative for osteoclastic bone resorption that took place during the initial phase of fracture healing process (Hobbs, 2003).

Periosteal reaction was observed on sixth week radiography. Because of a rigid fixation, periosteal callus was minimum (Hobbs, 2003) but periosteal bridging could be detected on eighth week radiograph.

Initial stages of bone resorption were observed on eighth week radiograph with marked areas of radiolucent zone around the graft on account of osteogenesis (Nair *et al.* 2009).

Signs of remodelling were observed at the end of the study. The graft and the fracture ends had good apposition throughout the study. The radiopacity of the biomaterial increased significantly throughout the study and was found integrated with host bone by the end of eight weeks (Figure 4).

Increase in the radiopacity of the biomaterial is a clear indication of the progressive healing of fracture which substantiates the osteoconductive and osteointegrative properties of the graft.

The study suggested that HASi bone graft substitutes could be successfully employed in clinical conditions of segmental defects such as high-energy trauma causing comminuted fractures which requires bone grafting due to the loss of bony fragments/segments.

## References

Emara, K.M., Diab, R.A. and Emara, A.K. 2015. Recent biological trends in management of fracture non union. *World J. ortho.* **6**(8): 623

Hobbs, S.L. 2003. Biology and radiological assessment of fracture healing. *In practice.* **25**: 26-35.

Houlton, J.E.F. and Dunning, D. 2005. Perioperative patient management. In: Johnson, A.L., Houlton, J.E. and Vannini, R. (ed.), *AO principles of fracture management in the dog and cat.* Georg Thieme Verlag, New York, pp: 8-22.

Kaler, J., Wassink, G.J. and Green, L.E. 2009. The inter and intra observer reliability of a locomotion scoring scale for sheep. *Vet. J.* **180**(2): 189-194.

Nascimento,C., Issa, J.P.M., Oliveira, R.R., Iyomasa, M.M., Siessere, S. and Regalo, S.C.H. 2007. Biomaterials applied to bone healing. *Int. J. Morphol*. **25**(4): 839-846.

Nair, M.B. 2009. Bone Reconstruction of Goat Femur Segmental Defects using tissue-engineered bioceramic scaffolds with osteogenically induced mesenchymal stem cells and platelet-rich plasma. *Ph.D. thesis*, Sri Chithira Thirunal Institute for Medical Science and Technology, Trivandrum, 235p.

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