INTRODUCTION: Current bone grafts include allograft and autografts, both of which have limitations. Autograft, regarded as the gold standard, has limited availability, donor site morbidity, increased operative time, blood loss and additional cost. Tissue engineering biotechnology has shown considerable promise in improving grafts. An optimal bone graft material must allow the interaction of three essential elements; a suitable cell source, growth and differentiation stimulating factors, and a scaffold matrix to support the attachment, migration, and proliferation of these cells. This provides an osseousductive and osseointegrative bone graft allowing the regeneration of bone. The objective of this study was to improve the osseointegrative capacity of human demineralised bone matrix (DBM) and human insoluble collagenous matrix (ICM), following incorporation of recombinant human osteogenic protein 1 (rhOP-1) and human mesenchymal stem cells (MSCs).

METHODS: Recombinant human osteogenic protein – 1 (400ng/0.25g of bone) was seeded onto DBM and ICM together with human MSCs (1 x 10^5). Cellular proliferation was quantitatively evaluated in vitro using Alamar Blue and 3H-TdR assays. Quantitative cellular differentiation was assessed using the alkaline phosphatase assay. Von Kossa staining, X-ray analysis, and PCR were used for qualitative evaluation of cellular differentiation. Qualitative analysis of proliferation and differentiation was assessed using scanning electron microscopy (SEM).

ESSENTIAL RESULTS: MSC proliferation and differentiation down the osteogenic lineage was observed on DBM and ICM in the presence of OP-1, and also on DBM alone. Alamar blue and 3H-TdR assays confirmed that MSC proliferation occurred on both DBM and ICM, with the values being significantly greater with addition of OP-1 (P≤0.05). The ALP activity showed that MSCs differentiated into osteoblasts on DBM alone, and on DBM and ICM with OP-1. In all cases, OP-1 had a significant effect on MSCs (P≤0.05).

DBM with OP-1 proved to be the best graft in terms of in vitro bone formation. The results of this study also confirmed DBM’s intrinsic osteoinductive capacity, as well as the pleiomorphic capabilities of OP-1.

DISCUSSION: DBM and ICM when seeded with MSCs and OP-1 provide an osteoconductive and osteointegrative graft material resulting in de novo bone formation. Hence both systems provide an improved osteoinductive graft.

ACKNOWLEDGEMENTS: Mr M Kayser, Dr P Sarathchandra, Dr N Gurav, Culyer Award (RNOHT)