Introduction
Treatment of chondral injuries remains a major issue despite the many advances made in cartilage repair techniques. Although it has been postulated that the use of marrow stimulation in combination with cell-based therapy may provide superior outcome, this has yet to be demonstrated. A pilot study was thus conducted to determine if bone marrow derived mesenchymal stromal cells (BM-MSCs) has modulatory effects on the repair outcomes of bone marrow stimulation (BMS) techniques.

Materials And Methods
Two full-thickness chondral 5mm diameter defects were created in tandem on the medial condyle of left stifle joints of eighteen Boer caprine (N=18). Goats were then divided equally in 3 groups. Simultaneously, bone marrow aspirates were taken from the iliac crests from the goats in Group 1 and were sent for BM-MSCs isolation and expansion in vitro. Six weeks later, BMS surgery which involves the subchondral drilling at the defect sites were performed. After 2 weeks, the knees in Group 1 were given autologous intra-articular BM-MSCs (N=6). In Group 2, although BMS was performed there were no supplementations provided. In Group 3, no intervention was administered. The caprines were sacrificed after 6 months. Repairs were evaluated using macroscopic assessment through international cartilage repair society (ICRS) scoring1, histologic grading by O'Driscoll score2, biochemical assays for glycosaminoglycans (GAGs) and gene expressions for aggrecan, collagen II and Sox9.

Results
Histological and immunohistochemical analyses demonstrated hyaline-like cartilage regeneration in the transplanted sites particularly in Group 1. In contrast, tissues in Groups 2 and 3 demonstrated mainly fibrocartilage. The highest ICRS and O'Driscoll scorings was also observed in Group 1, while the lowest score was seen in Group 3. Similarly, the total GAG/total protein as well as chondrogenic gene levels were expressed in the same order, i.e. highest in Group 1 whilst the lowest in Group 3. Significant differences between these 3 groups were observed (p<0.05).

Discussions
Data from the present study suggests that the use of BM-MSCs as an adjunct therapy provides certain levels of improvements to this method of cartilage repair. Several limitations were however identified and require improvement in future studies. These includes further improving the treatment arm that utilizes a standard treatment approach for cartilage repair such as hyaluronic acid injection, using a larger number of animals, and increasing evaluation of result at few time points.
Conclusions
This study suggests that supplementing intra-articular injections of BM-MSCs following BMS knee surgery provides superior cartilage repair outcomes.

References