A statistical analysis on the relationship of combining multiple variables and fibroblast colony-forming units in bone marrow aspiration

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Introduction

- Critical minimal fibroblast colony-forming units (CFU-f) levels are necessary to predict success of musculoskeletal conditions such as osteoarthritis of the knee , rotator cuff [1] tears , degenerative disc disease, and non-unions.
- CFU-f results normally [2][3][4] take between 10-14 days to complete.
- Total nucleated counts (TNC) are a quick, accurate process performed bedside in a matter of minutes.
- Previous studies show moderate correlations between TNC and Mesenchymal Stem Cell (MSC) counts or [5] CFU-f as well as age of the patient and harvest techniques.
- No previous studies have [6][7] correlated a combination of these multiple variables to predict the CFU-f.

Purpose

- Combining the variables of age, aspiration technique and TNC will provide a reliable correlation to CFU-f counts at the time of bone marrow harvest allowing for a predictive bedside model on the volume of bone marrow harvest required to deliver the critical minimal level of CFU-f.

Results

- Moderate to high Spearman's correlation coefficient between the actual and predicted CFU-fs/mL were found.
- One physician submitted 32 BMC samples providing a coefficient of 0.91 for the actual BMC CFU-f and BMC TNC, and a coefficient of 0.83 for the actual BMC CFU-f and predicted BMC CFU-f.
- Another physician with 22 samples provided CFU-f and predicted BMA CFU-f of 0.64, while the coefficient for the actual BMA CFU-f and BMA TNC was 0.76.

The relationship between CFU-f per mL of a BMC sample and the TNC per mL of the same BMC sample (A) with the 36 outliers and (B) without the outliers with trend line.

The relationship between CFU-f per mL of a BMA sample and the TNC per mL of the same BMA sample (A) with the 17 outliers and (B) without the outliers with trend line.

The actual and predicted values of CFU-f per mL with their corresponding TNC per mL of (A) BMC and (B) BMA.
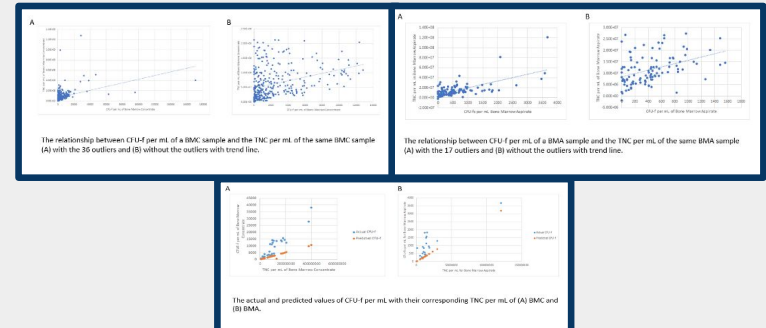
Methods

- Over 53 bone marrow iliac crest aspirations from multiple clinic sites were submitted for TNC, viability and CFU-f analysis.
- Results were compared to a predictive model combining age, TNC, and viability.
- Further refinement was made using average recovery rates with the ART BMC system (Celling Biosciences, Austin, TX) as well as segregating the harvesting techniques between 4-6 cc per aspiration within a 10 cc syringe.
- Statistical analysis was run using the Spearman's rank order correlation test.

Conclusions

- Our current predictive model combining age, aspiration technique and TNC provides a strong correlation coefficient providing a reliable bedside method to predict the amount of bone marrow aspirate necessary to produce a clinically relevant CFU-f dosing.

References

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