# Advanced Bone Marrow Aspiration and Concentration Technique using the XCELL BMC

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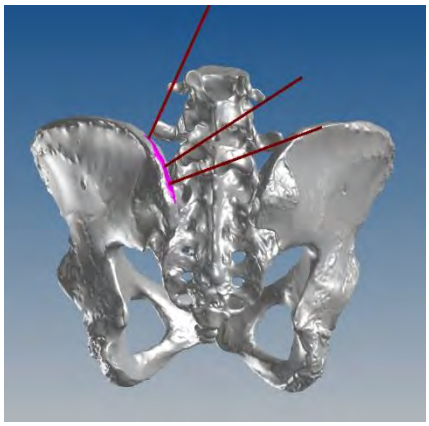
## Bone Marrow Aspiration

Seven patients between April and June 2019 received injections of autologous bone marrow concentrate (BMC). 60cc bone marrow aspirate (BMA) was obtained in a method developed to maximize total nucleated cell (TNC) and mesenchymal stem cell (MSC) concentrations. All instruments were washed or flushed with heparin solution (1000 units/mL) prior to use. Following anesthetization with 1% lidocaine, the posterior iliac crest is accessed with a drill-powered 15g bone marrow biopsy needle. Multiple 10cc syringes preloaded with 1cc heparin solution are utilized, similarly to the technique developed by Philippe Hernigou[1], with quick pulls and obtaining 1-3cc BMA per depth. The needle is advanced deeper into the cancellous bone for additional BMA collection until approximately 10cc is obtained per aspiration site. New channels are accessed (up to 6 per iliac wing) to obtain additional BMA until 60cc is collected (see figure below).



*Aspiration needle trajectories in the posterior iliac crest perpendicular to the surface and between the inner and outer tables.*

## Bone Marrow Concentrate

60cc anticoagulated BMA was passed through a 150-micron clot filter, loaded into the XCELL BMC device, and centrifuged for 14 minutes at 3800rpm. After centrifugation, the separated BMA fractions (plasma, buffy coat, and hematocrit) are pushed upward to the collection syringe at the top of the device. Platelet-poor plasma (PPP) is removed into a 60cc syringe until 3-7cc remains, based on physician preference for the intended use. Next, the remaining PPP, buffy coat (white blood cells and platelets), and approximately 3cc of hematocrit is pushed into a 10cc syringe. .5cc well-mixed samples of BMA and BMC were sent to an independent laboratory (BioSciences Research Associates, Cambridge, MA, USA) for characterization of TNC, platelets, and hematocrit. The average results for BMA and BMC (n=7) are shown in Table 1 and Table 2.

**Table 1.** Average volume, TNC and Platelet (PLT) concentration in BMA and BMC, and Percent Recovery.

| *n=7* | Avg. Vol (mL) | TNC conc. (millions/ mL) | PLT/mL (millions /mL) | TNC Recovery % | PLT Recovery % |
|---|---|---|---|---|---|
| **BMA** | 60.0 | 35.9 | 149.9 | n/a | n/a |
| **BMC** | 9.7 | 185.1 | 651.6 | 84.7% | 74.7% |

**Table 2.** Enrichment over BMA in BMC.

| *n=7* | TNC Enrichment over BMA | PLT Enrichment over BMA | Total TNCs (billion) | Avg. % HCT |
|---|---|---|---|---|
| **BMA** | n/a | n/a | 2.15 | 32% |
| **BMC** | 5.5x | 4.6x | 1.80 | 26% |

## Conclusions

Aspirating marrow from multiple sites (<10cc per site) with rapid acceleration of syringe plunger results in significantly greater TNC concentrations than has been previously reported in the literature for >10cc collection per site (39.9 million/mL compared to <25 million/mL). The XCELL BMC device averaged 84.7% recovery of TNC from a 60cc sample of BMA. TNC and PLT enrichment are dependent on the total BMC volume the physician chooses, but for an average BMC volume of 9.7 mL the average TNC enrichment was 5.5x and platelet enrichment was 4.6x over baseline BMA.

## About the Author

Dr. Atluri is a frequent lecturer and instructor at the annual meetings and regenerative courses of the American Society of Interventional Pain Physicians [ASIPP]. He is also a co-editor of one of the largest textbooks about Regenerative Medicine. Dr. Atluri is part of the team which wrote the ASIPP guidelines for stem cell therapy to treat back pain. He is certified in Regenerative Medicine by American Society of Interventional Pain Physicians. The BMA technique described herein was developed solely by Dr. Atluri in his clinical regenerative medicine practice.

**References:**

Hernigou P, et al. "Benefits of small volume and small syringe for bone marrow aspirations of mesenchymal stem cells." Nov. 2013, 37 (11), pp 2279–2287