Role of Osteogenically Differentiated and Undifferentiated Stem Cells From Adipose Tissue and Bone Marrow On Bone Regeneration In Critical Sized Calvarial Defects

Salim Iskender, Muhitdin Eski, Dogan Alhan, Cagri Uysal, Armagan Gunal, Ferit Avcu, Inanc Guvenc, Selcuk Isik.

Gulhane Military Medical Academy, Ankara, Turkey

Nothing to disclose

Objective of the Study

To examine the role of adipose-derived and bone marrow-derived stem cells and osteoblasts on bone regeneration

Materials and Methods

Cell Preparation

Bone marrow

Bone marrow derived stem cell (BMSC)

Osteogenic differentiation (BMSC-ob)

Fluorescent labelling (CM-DiI)

Adipose tissue

Adipose tissue derived stem cell (ASC)

Osteogenic differentiation (ASC-ob)

Materials and Methods

Experimental Model

Schmitz and Holinger

Critical sized (8 mm)

rat calvarial defect

Diameter: 8 mm

Materials and Methods

Experimental Groups

Group 1 (n=8) : No cells, no carrier

Group 2 (n=8) : No cells, only gelatin carrier

Group 3 (n=8) : ASC + gelatin carrier

Group 4 (n=8) : ASC-ob + gelatin carrier

Group 5 (n=8) : BMSC + gelatin carrier

Group 6 (n=8) : BMSC-ob + gelatin carrier

Materials and Methods

Evaluation

1. Defect measuring with computerized tomography (CT)

    - at 0, 2, 4. and 8. weeks postoperatively

2. Histological analysis

3. Fluorescent microscope (CM-DiI)

4. Immunohistochemistry (osteocalcin and vWF)

Results
Computerized Tomography

Group		0. week	2. week	4. week	8. week
1	Mean	47,25	46,88	45,63	43,63
	Std. Deviation	2,915	2,900	2,446	2,669
2	Mean	47,00	46,38	45,00	43,38
	Std. Deviation	2,726	2,446	2,390	2,722
3	Mean	48,00	47,25	44,38	35,50
	Std. Deviation	2,268	2,121	3,583	5,855
4	Mean	46,50	45,88	43,38	34,13
	Std. Deviation	3,251	3,399	3,623	6,244
5	Mean	48,38	47,75	45,25	35,88
	Std. Deviation	3,292	3,615	3,991	5,111
6	Mean	47,50	46,88	44,38	35,13
	Std. Deviation	2,390	2,532	2,973	6,357

Results
Computerized Tomography

Kruskal – Wallis test

- no significant difference between groups at 0, 2nd and 4th weeks ($p>0.05$)
- significant difference between groups at “8th week” ($p<0.05$)

Results

Computerized Tomography

Mann – Whitney U Test with

Bonferroni Correction

- significant difference between 1st group and 3rd, 4th, 5th, 6th groups at 8th week
- significant difference between 2nd group and 3rd, 4th, 5th, 6th groups at 8th week

Results

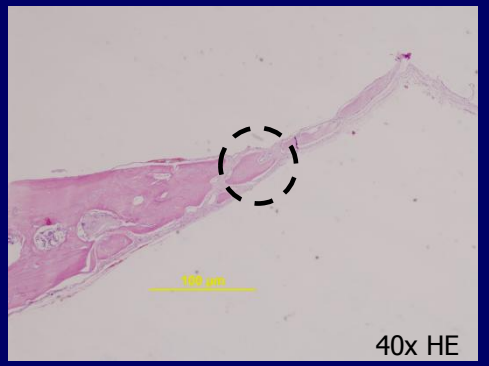
Computerized Tomography

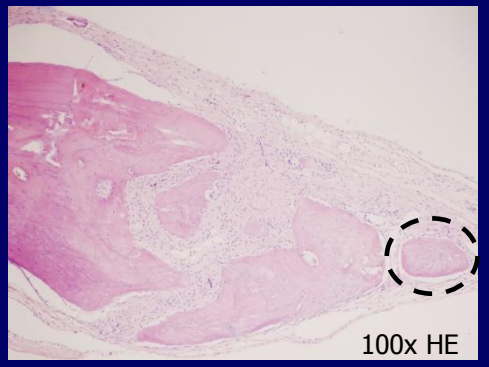
Friedman and Wilcoxon Tests

- no significant difference in 1st and 2nd groups between weeks
- significant difference in each cell-based therapy group (3, 4, 5 and 6) between 0. and 8th weeks

Results
Histology

Cell-based therapy groups (3-6) exhibited new bone islands

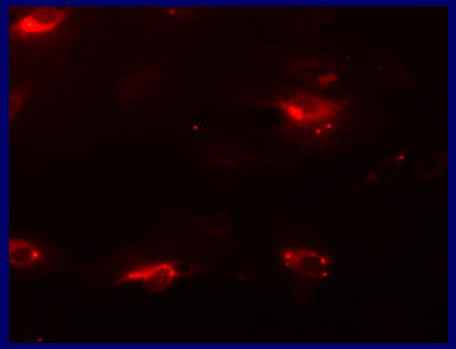




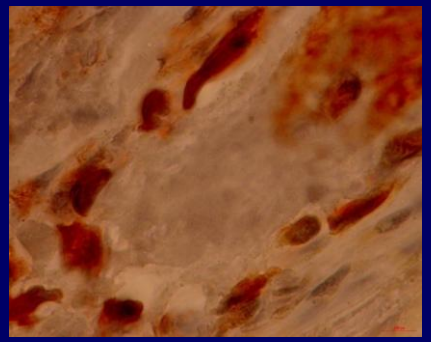
Results

Immunohistochemistry

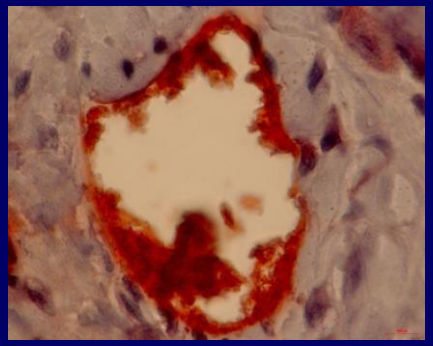
Viable stem cells, osteoblasts and endothelial cells in the cranial defect site



CM-DiI (Invitrogen, USA)



Osteocalcin



vWF

Conclusion

Cell-based therapy groups (3, 4, 5 and 6) proved to have more osteogenic potential compared with the control and carrier groups (1 and 2).

Conclusion

There was no significant difference in terms of new bone formation between osteogenically induced and non-induced stem cells from bone marrow and adipose tissue.

Conclusion

Significance of the Findings

- Osteogenic differentiation is not a necessity for stem cells
- Adipose tissue is the preferred source with advantages of high yield and rapid expansion