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Department of Orthopedics

OUTCOMES OF BONE MARROW STIMULATION WITH AND WITHOUT EXTRACELLULAR MATRIX CARTILAGE ALLOGRAFT

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Background

- Adult cartilage has limited regenerative potential
- The mainstay surgical treatment for small (<1.0 cm^2) focal OLTs is bone marrow stimulation (BMS) which releases pluripotent bone marrow stem cells in to the defect
- Extracellular Matric Cartilage Allograft (EMCA) has been explored as a potential adjuvant treatment in treating OLT
- Fortier et al. demonstrated significantly better cartilage repair following adjuvant EMCA and platelet-rich plasma therapy compared to BMS alone in an equine model

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Purpose

- The purpose of this study is to evaluate the effectiveness of Extracellular Matrix Cartilage Allograft (EMCA) as an adjuvant to bone marrow stimulation (BMS) compared to BMS alone in the treatment of osteochondral lesions of the talus (OLT).

Hypothesis

- Our hypothesis was that EMCA would result in improved radiological findings in those undergoing BMS, but that short term follow-up would not be sufficient to show improved clinical outcomes

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Methods

- A retrospective cohort study comparing patients treated with BMS with EMCA **(BMS-EMCA group)** and BMS alone **(BMS group)** between 2013 and 2019

- Patients between 2013 and 2015 were treated with **BMS**

- patients between 2016 and 2019 were treated with **BMS with EMCA**

- The indications for BMS were:
  - Patients with OLTs that had failed 3 months of conservative management
  - Lesion size was smaller than 15 mm or 150 mm^2 without large cystic lesions.
  - *Presence of shoulder lesions did not exclude patients from receiving this treatment, so long as the lesion size was no larger than 15 mm or 150 mm^2

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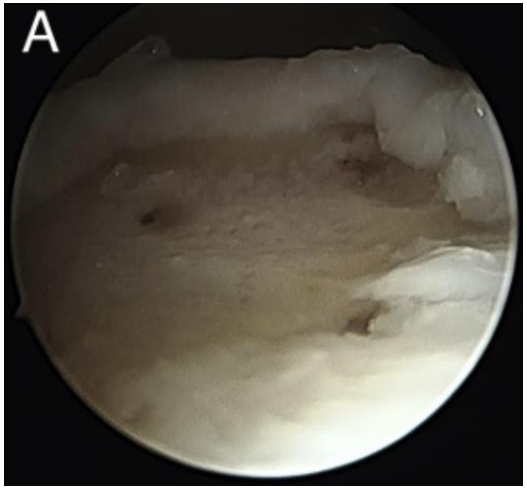
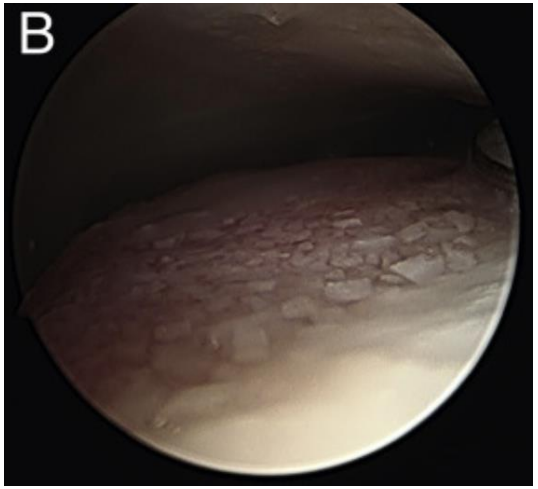
Methods
Surgical Technique

- The operative technique for BMS with EMCA was carried out arthroscopically



Microfracture was performed using an awl



Then the mixture of EMCA and CBMA was applied into the defect

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Methods
Outcomes Measured

- Clinical outcome was evaluated with the Foot and Ankle Outcome Score (FAOS) pre- and postoperatively
  - Patients were routinely followed-up at 2-weeks, 6-weeks, 3-months, 6-months and 12-months post-operatively

- Postoperative MRIs were evaluated using a modified Magnetic Resonance Observation of Cartilage Tissue (MOCART) score.
  - The MRI's were not performed solely for research purposes, but were performed as part of routine follow-up in patients (at minimum 12 months)

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Methods
Statistical Analysis

- Comparisons between groups were made with the Man-Whitney U test for continuous variables and the χ^2 or Fisher exact test for categorical variables.

- The Wilcoxon signed-rank test was performed to compare preoperative and postoperative outcome scores and MOCART score.

- The minimal clinically important difference (MCID) was calculated using a distribution-based method of standard deviation (SD): MCID = 0.5* SD

- A value of p <0.05 was considered statistically significant

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Results
Clinical Characteristics

- 48 patients who met the inclusion/exclusion criteria were included in this study
- Twenty-four patients underwent BMS with EMCA (BMS-EMCA group) and 24 patients underwent BMS alone (BMS group)
- The mean follow-up time was longer for the BMS group (mean 26.9 months, range 12-55 months) compared with the BMS-EMCA group (20.0 months, range 12-36 months) (p=0.031)
- Patients in the BMS-EMCA group had higher percentage of prior BMS (33.3%), compared with the BMS group (4.2%)

Clinical Characteristics	BMS Alone (N = 24)	BMS + EMCA (N = 24)	P Value
Age, mean	40.8 ± 14.7	47.8 ± 10.1	0.06
Male gender, No. (%)	14 (58.3%)	11 (45.8%)	0.39
Right ankle, No. (%)	11 (45.8%)	13 (54.2%)	0.56
Duration of symptoms, mo, mean	6.4 ± 8.4	12.1 ± 16.6	0.23
Follow-up, mo, mean	26.9 ± 12.2	20.0 ± 8.5	0.03*
Defect location on the talus			
L1, No. (%)	1 (4.2%)	0 (0%)	0.31
L2, No. (%)	0 (0%)	0 (0%)	N/A
L3, No. (%)	2 (8.3%)	1 (4.2%)	0.55
L4, No. (%)	7 (50.0%)	11 (45.8%)	0.23
L5, No. (%)	1 (4.2%)	2 (8.3%)	0.55
L6, No. (%)	6 (25.0%)	5 (20.8%)	0.73
L7, No. (%)	4 (16.7%)	2 (8.3%)	0.38
L8, No. (%)	0 (0%)	0 (0%)	N/A
L9, No. (%)	3 (12.5%)	3 (12.5%)	1
Defect size, mm2, mean	33.0 ± 25.4	31.3 ± 19.4	0.8
Shoulder lesion, No. (%)	21 (87.5%)	16 (66.7%)	0.09
Cystic, No. (%)	10 (41.7%)	7 (29.2%)	0.37
Prior BMS, No. (%)	1 (4.2%)	8 (33.3%)	0.01*
Concomitant procedure, No. (%)	19 (79.2%)	18 (75.0%)	0.73

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Results
Clinical Outcomes

TABLE 2. FAOS Data

FAOS Subscale		BMS Alone (N = 24)	BMS + EMCA (N = 24)	P Value
Symptoms	Pre-Op	59.8 ± 16.8	55.1 ± 13.0	0.33
	Post-Op	73.3 ± 11.0	71.4 ± 12.9	0.60
Pain	Pre-Op	59.4 ± 16.4	53.8 ± 13.6	0.27
	Post-Op	79.3 ± 11.1	76.8 ± 12.1	0.47
ADL	Pre-Op	70.4 ± 18.0	61.1 ± 11.7	0.07
	Post-Op	86.0 ± 8.8	87.1 ± 7.8	0.66
Sports	Pre-Op	53.2 ± 18.6	39.7 ± 18.1	0.04*
	Post-Op	60.9 ± 18.7	60.9 ± 14.0	0.99
QOL	Pre-Op	33.3 ± 17.6	29.4 ± 12.0	0.43
	Post-Op	60.6 ± 18.1	53.2 ± 18.4	0.18

TABLE 3. MCID Analysis of FAOS

	FAOS Subscale	BMS Alone	BMS + EMCA	P Value
N(%), Δ ≥ MCID	Symptoms	14 (70.0%)	16 (76.2%)	0.66
	Pain	15 (75.0%)	18 (85.7%)	0.39
	ADL	14 (70.0%)	18 (85.7%)	0.22
	Sports	12 (60.0%)	15 (71.4%)	0.44
	QOL	15 (75.0%)	16 (76.2%)	0.93

Δ=Postop score - Preop score

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Results
MRI Outcomes

TABLE 4. MOCART Evaluation of Repair Tissue

Variable	BMS Alone (N = 15)	BMS + EMCA (N = 16)	P Value
Degree of defect infill, n (%)			
Complete	7 (46.7)	14 (87.5)	0.015
Hypertrophy	1 (6.7)	1 (6.3)	0.962
Incomplete			
>50% of the adjacent cartilage	3 (20)	0	0.060
<50% of the adjacent cartilage	1 (6.7)	0	0.294
Subchondral bone exposed	3 (20)	1 (6.3)	0.254
Integration to border zone, n (%)			
Complete	8 (53.3)	13 (81.3)	0.097
Incomplete			
Demarcating border visible	2 (13.3)	1 (6.3)	0.505
Defect visible			
<50% of the length of the repair tissue	1 (6.7)	0	0.294
>50% of the length of the repair tissue	4 (26.7)	2 (12.5)	0.318
Surface of repair tissue, n (%)			
Surface intact	8 (53.3)	8 (50)	0.853
Surface damaged			
<50% of repair tissue depth	3 (20)	8 (50)	0.081
>50% of repair tissue depth or total degeneration	4 (26.7)	0	0.027
Structure of the repair tissue, n (%)			
Homogeneous	8 (53.3)	9 (56.3)	0.871
Inhomogeneous	7 (46.7)	7 (43.8)	
Signal (PD) intensity of the repair tissue, n (%)			
Isointense	10 (66.7)	8 (50)	0.347
Moderately hyperintense	4 (26.7)	8 (50)	0.183
Markedly hyperintense	1 (6.7)	0	0.294
Subchondral lamina, n (%)			
Intact	9 (60)	12 (75)	0.372
Not intact	6 (40)	4 (25)	
Subchondral bone, n (%)			
Intact	0	3 (18.75)	0.078
Not intact (edema or subchondral cyst)	15 (100)	13 (81.3)	
Adhesions, n (%)			
No	15 (100)	16 (100)	1.0
Yes	0	0	

Shows insufficient infill by BMS

Shows complete infill by BMS with EMCA.

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Limitations

- Retrospective cohort study with short-term follow-up
- Differences in patient follow-up time points
- Differences in history of prior BMS
- Small number of subject in either group
- High rates of concomitant procedures between both groups

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Conclusions

- BMS with EMCA is an effective treatment strategy for the treatment of OLT and provides better cartilage infill in the defect on MRI.
- However, this did not translate to improved functional outcomes compared with BMS alone in the short-term.
- Additionally, according to the minimal clinically important difference (MCID) analysis, there was no significant difference in clinical function scoring between either group postoperatively.

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THANK YOU

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