Bone Marrow Concentrate Intra-Articular Injections for Knee Osteoarthritis: Updated 5-Year Clinical Outcomes in 71 Patients

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Editor:

The long-term effectiveness of intra-articular bone marrow concentrate (BMC) injections for knee osteoarthritis (OA) remains underexplored. Although short-term outcomes are promising, sustained clinical benefit over several years is not well documented. Clinical outcomes at 1 year were previously reported for 96 patients prospectively treated between 2017 and 2018 (1). This letter follows up on the earlier publication and presents 5-year clinical follow-up data from 71 (74%) patients with patellofemoral OA who received ultrasound (US)-guided intra-articular BMC injection.

The study was registered with the Agence Nationale de Sécurité du Médicament (ANSM, registration number 2017-A01894-49) and conducted in accordance with the tenets of the Declaration of Helsinki. Comité d'Ethique de Recherche Clinique Vivalto Santé institutional ethics review board approval was obtained (reference number 06-2019.2). Baseline patient characteristics are summarized in the **Table**. Responders (n = 38) were defined as those achieving a minimal clinically important difference of ≥10 points in Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) at 1 year. Responders and nonresponders (n = 33) were similar in age (52.7 years [SD ± 13.6] vs 56.4 years [SD ± 9.9]; $P = .317$), body mass index (25.4 kg/m^2 in both; $P = .957$), and sex distribution (19:19 vs 21:12; $P = .337$). However, responders had higher baseline WOMAC (41.2 [SD ± 15.4] vs 28.0 [SD ± 17.0]; $P = .001$) and visual analog scale (VAS) scores (6.0 [SD ± 1.9] vs 4.7 [SD ± 2.0]; $P = .006$), and lower International Knee Documentation Committee (IKDC) scores (41.6 [SD ± 12.0] vs 49.1 [SD ± 12.8]; $P = .012$).

Table 1. Baseline Clinical Characteristics and Demographics of Patients and Biological Characteristics of Bone Marrow Concentrate Injected

Characteristic	Responders (n = 38)	Nonresponders (n = 33)	*P* value
Sex (M:F)	19:19	21:12	.337
Age (y)	52.7 ± 13.6	56.4 ± 9.9	.317
BMI (kg/m^2)	25.4 ± 3.9	25.4 ± 4.1	.957
KL Grade II-III	27 (71%)	19 (56%)	.319
KL Grade IV	11 (29%)	14 (42%)	
IKDC score at baseline	41.6 ± 12.0	49.1 ± 12.8	**.012**
WOMAC at baseline	41.2 ± 15.4	28.0 ± 17.0	**.001**
VAS score at baseline	6.0 ± 1.9	4.7 ± 2.0	**.006**
Injected volume (mL)	17.3 ± 2.7	16.3 ± 3.4	ns
Quantity of injected leucocytes (×10^6)	509 ± 303	476 ± 242	ns
Quantity of injected mononuclear cells (×10^6)	215 ± 104	212 ± 119	ns
Quantity of injected granulocytes cells (×10^6)	304 ± 209	259 ± 142	ns
Quantity of injected red blood cells (×10^9)	9.2 ± 4.0	9.9 ± 6.3	ns
Quantity of injected platelets (×10^6)	7,166 ± 3,154	7,533 ± 4,730	ns

Note–Data are provided as mean ± SD, n (%), or absolute values. Bold values indicate statistical significance.
BMI = body mass index; F = female; IKDC = International Knee Documentation Committee; KL = Kellgren-Lawrence; M = male; ns = not significant; VAS = visual analog scale; WOMAC = Western Ontario and McMaster Universities Osteoarthritis Index.

The BMC harvesting and injection technique was described previously (1). In brief, BMC was obtained via US-guided iliac crest aspiration, processed using a standardized centrifugation protocol, and injected under US guidance into the patellofemoral joint without adjunctive intra-articular therapies. Cell counts and injected volumes were similar between groups. Baseline biological characteristics of the injected BMC were comparable between groups (**Table**). There were no significant differences in injected volume or in the cellular components of the injectate, including leukocytes, mononuclear cells, granulocytes, red blood cells, and platelets.

At 1 year, responders showed marked improvement: WOMAC decreased by −22.0 (SD ± 11.5), VAS score decreased by −2.9 (SD ± 2.2), and IKDC score increased by +21.4 (SD ± 13.8; all $P < .001$). Nonresponders experienced minimal change (WOMAC, +0.3 [SD ± 9.2]; $P = .359$). At 5 years, responders maintained a significant reduction in WOMAC (−16.5 [SD ± 18.6]; $P < .001$) and VAS score (−1.8 [SD ± 2.4]; $P < .001$) and an increase in IKDC score (+15.1 [SD ± 18.8]; $P < .001$). Nonresponders remained clinically stable. At 5 years, nonresponders showed slight, nonsignificant changes from baseline (WOMAC, −3.6 [SD ± 15.7]; IKDC score, +3.5 [SD ± 16.9]; VAS score, −0.5 [SD ± 1.5]; all nonsignificant) (**Fig 1**).

By the 5-year follow-up, clinical scores had largely converged between the 2 groups. Although responders

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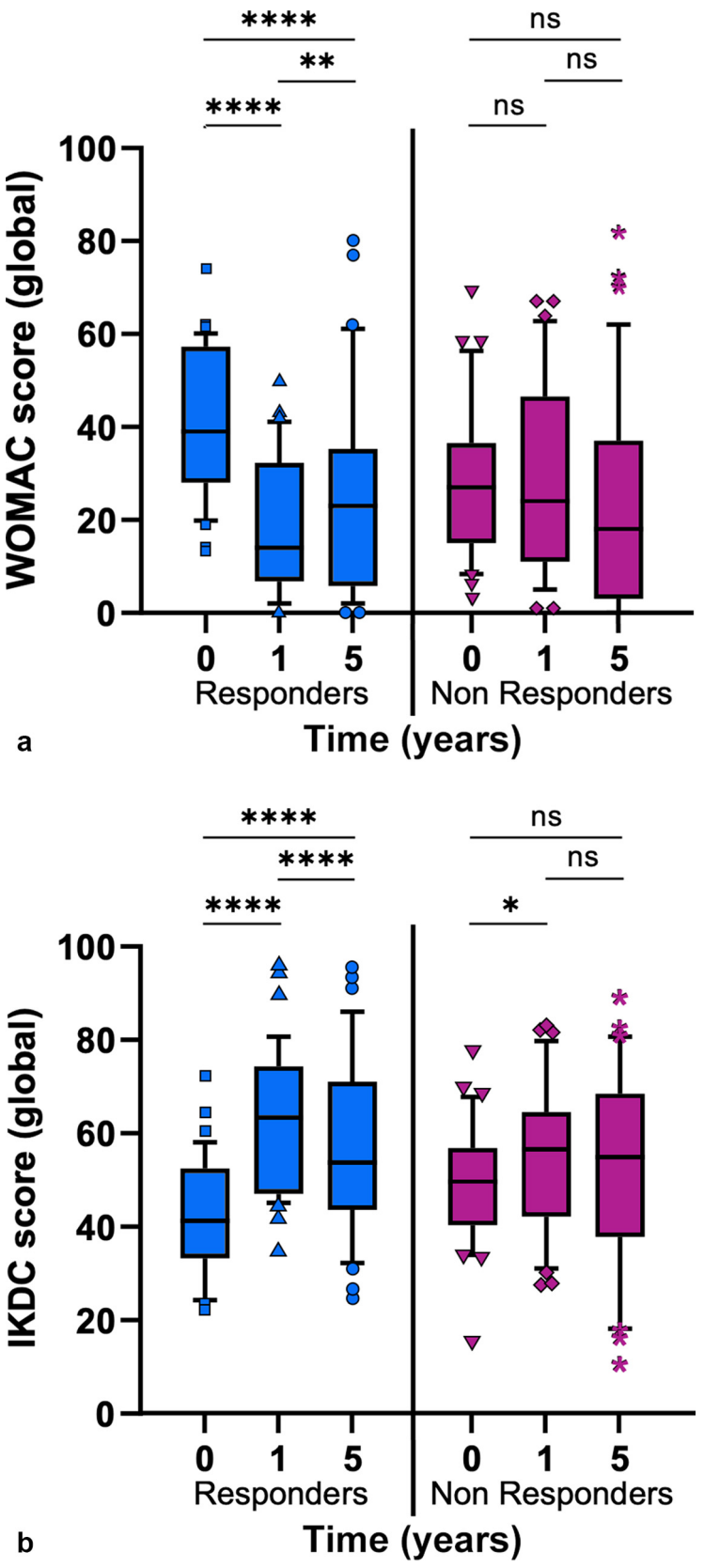

Figure 1. Changes in the **(a)** Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), **(b)** International Knee Documentation Committee (IKDC) score, and **(c)** visual analog scale (VAS) scores (absolute values) after bone marrow concentrate treatment therapy at baseline, 1 year, and 5 years. Box and whisker plots represent the median, the lower and upper quartile, and the minimum and maximum, respectively. Mann-Whitney test (2-tailed) was used to compare groups. *$P < .05$; **$P < .01$; ****$P < .001$. ns = not significant.

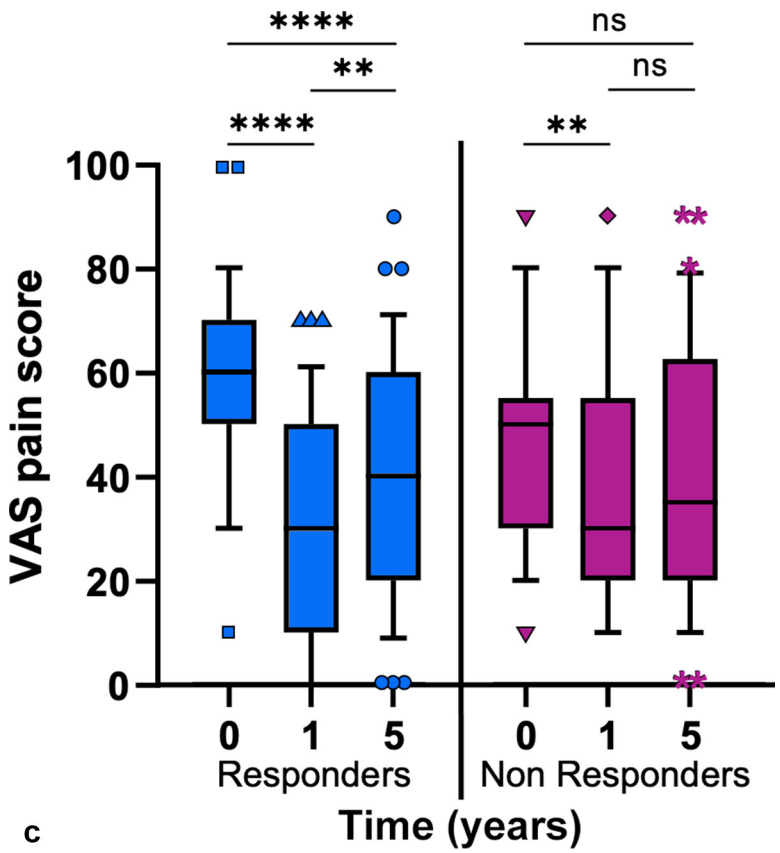

Figure 1. (*continued*).

experienced a steeper initial improvement, their gradual decline in scores contrasted with the consistent stability observed in nonresponders. This raises the possibility that baseline symptom severity may influence the trajectory of clinical response. Patients with higher initial WOMAC scores had more room for improvement and responded more strongly to BMC but possibly also had more active or progressive disease, contributing to later symptom recurrence. To explore this further, a subgroup analysis based on baseline WOMAC scores was conducted. Patients with WOMAC ≥40 experienced significantly greater improvements at both 1 and 5 years than those experienced by patients with WOMAC <40, although both subgroups reached comparable clinical status at Year 5. This supports the notion that patients with greater initial symptom burden may perceive more pronounced therapeutic gains. Lack of variation in the injected BMC suggests that biological variability in the BMC composition was not a primary determinant of clinical response in this cohort.

Although long-term follow-up data for the untreated control group from the original study were not available, prior literature on the natural history of knee OA suggests expectation of gradual clinical deterioration over time. The sustained clinical improvements seen in responders, combined with symptom stabilization in nonresponders, provide preliminary support for a potential disease-modifying effect of BMC therapy.

In conclusion, a single BMC injection may offer durable symptom relief or disease stabilization in selected patients with patellofemoral OA. Although the absence of a control group limits definitive conclusions, these findings support the potential long-term utility of intra-articular BMC and warrant further prospective investigation.

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Percutaneous Drainage for Pancreatitis, Panniculitis, and Polyarthritis Syndrome

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Figures E1 and E2 can be found by accessing the online version of this article on *www.jvir.org* and selecting the Supplemental Material tab.

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