

Complications of BMAC Injections for Orthopaedics: A Systematic Review

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None



Objective

To investigate the complications of
BMAC used for orthopaedic
conditions



Introduction

- Bone marrow aspirate concentrate (BMAC) is a source of stem cells and growth factors that can be used to promote healing
- Used for a variety of orthopaedic conditions from osteoarthritis, tendon tears, osteochondral lesions, and ligament reconstruction
- Complications of these injections are little understood and should be elucidated for adequate informed consent



Methodology

Search strategy: “((bone marrow) AND (aspirate OR “concentrate”)) OR (BMAC) AND (Orthopaedic OR orthopedic))”

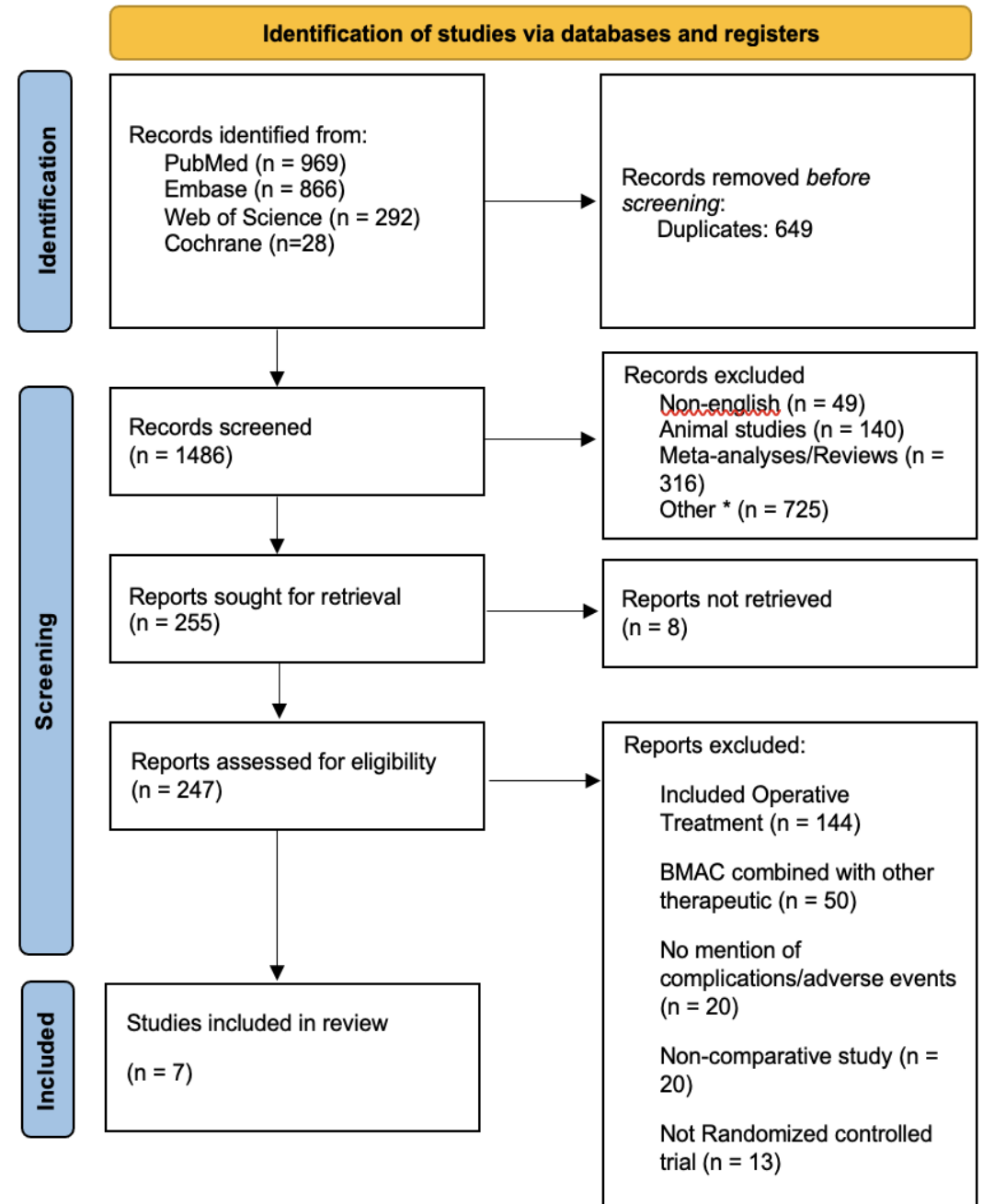
Inclusion Criteria	Exclusion Criteria
Randomized controlled trial (RCT)	Other study designs, eg: cohort, case-control, case report
BMAC in isolation	Combined treatment or compared to non-injectable
No surgical intervention (to avoid confounding)	Not an orthopaedic condition
Reports complications/adverse events (Including if study said “no complications”)	No mention of complications/adverse events
Compared BMAC to other injectables	Basic science study/non-human study



Study Screening

- 1486 records identified
- 254 deemed eligible for inclusion
- **Excluded:**
 - 144 as operative intervention
 - 50 for combining BMAC with another therapeutic
 - 21 for not mentioning complications
 - 33 for not being a randomized controlled trial

- **7 Studies included in the review**





Results Highlights

- 7 studies identified, 6 on knee osteoarthritis, 1 on glenohumeral arthritis
- 494 patients, 274 of whom received BMAC
- Most commonly reported complication was pain
- Overall complication rate:
 - BMAC group: 29.56%
 - Comparison group: 27.27%
- Number needed to harm: 44
 - In order to get one more complication over comparison group need to inject 44 patients
- 3 patients had moderate pain requiring pharmacologic treatment otherwise all other complications were described as "minor"



Table 1. Study Demographics

Author	Study Design	Journal	Year	Condition Studied	Complications (Y/N)	Number of Patients (Number of Patients per Group BMAC/Comparison)	Follow-up (months)	Comparison Group	Age of BMAC group	Age of Comparison group	Sex in BMAC group (M:F)	Sex in Comparison group (M:F)	Consort Score
Shapiro	RCT	AJSM	2017	Knee Osteoarthritis	Y	50 (25/25)	6	Saline	60	60	7:18	7:18	21
Bastos	RCT	Knee	2018	Knee Osteoarthritis	Y	18 (9/9)	12	PRP combined with BMAC	54.7 +/- 7.2	60.4 +/- 11.3	5:4	4:5	22
Dwyer	RCT	ASMR	2021	Glenohumeral Osteoarthritis	N	25 (13/12)	12	Cortisone injection	61.6	53.8	8:5	9:3	21
Boffa	RCT	KSSTA	2021	Knee Osteoarthritis	Y	112 (56/56)	24	Hyaluronic Acid Injection	57.8 +/- 8.9	57.8 +/- 8.9	35:21	35:21	22
Dulic	RCT	Medicina	2021	Knee Osteoarthritis	Y	175 (111/64)	12	Hyaluronic acid or PRP (3 arm study)	56.9 +/- 10.8	HA: 59.4 +/- 14.0 PRP: 58.5 +/- 11.2	57:54	HA: 13:17 PRP: 15:19	20
Vega	RCT	Transplantation	2015	Knee Osteoarthritis	Y	30 (15/15)	12	Hyaluronic Acid Injection	56.6	57.3	6:9	5:10	19
Anz	RCT	OJSM	2020	Knee Osteoarthritis	N	84 (45/39)	12	Platelet Rich Plasma (PRP)	55.8	52.2	27:18	22:17	



Table 2. Most commonly reported complications and complication rates

	# in BMAC group	# in Control group	Rate of complication BMAC	Rate of complication comparison	ARR	NNH	P value
Pain	42	24	15.33%	10.91%	4.42%	23	0.15
Effusion	24	20	8.76%	9.09%	0.33%	301	0.90
Inflammation	7	5	2.55%	2.27%	0.28%	355	0.84
Other*	8	11	2.92%	5.00%	2.08%	48	0.23

ARR = Absolute Risk Reduction
NNH = Number Needed to harm

*Other consisted of: menstrual disorders, influenza, migraine, toothache, restlessness, memory loss, testicle pain, rhinitis, sensitive hand alteration, sleepiness, allergic rxn, tinnitus, dental implant, lipoma, skin tumor



Conclusion

- Overall BMAC injections are safe compared to other injectables with mainly minor complications.
- In order for one patient to experience a complication from a BMAC injection compared to other injectables, 44 patients would need to receive a BMAC injection.
- The reporting of complications by RCTs is important for proper informed consent and evaluation of procedure safety



References

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