



Stromal Vascular Fraction for Knee Osteoarthritis: A Scoping Review of Randomized Controlled Trials

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INTRODUCTION

Knee osteoarthritis (OA) is one of the most prevalent musculoskeletal conditions, causing chronic pain, functional impairment, and reduced quality of life. Current non-surgical treatments provide only short-term symptom relief without disease-modifying effects.

Stromal vascular fraction (SVF), derived from autologous adipose tissue, contains a heterogeneous cell population including mesenchymal stem cells, endothelial progenitor cells, pericytes, and immune cells. SVF has emerged as a promising regenerative therapy for knee OA due to its anti-inflammatory and tissue-repair potential. This scoping review systematically maps the current evidence from randomized controlled trials (RCTs) evaluating the efficacy and safety of intra-articular SVF injection for knee OA.

METHODS

Search Strategy

A systematic search was conducted in PubMed/MEDLINE, Embase, Cochrane CENTRAL, Web of Science, and Scopus from inception to September 2025, following PRISMA-ScR guidelines. The protocol was prospectively registered on the Open Science Framework (OSF).

Eligibility Criteria

- Population: Adult patients with knee OA | • Intervention: Intra-articular SVF injection
- Comparator: HA, corticosteroid, saline/placebo, or no treatment
- Study design: Randomized controlled trials only
- Outcomes: Pain (VAS), function (WOMAC, KOOS), imaging, and safety

Study Selection

Two independent reviewers screened records through title/abstract and full-text stages. Discrepancies were resolved by discussion or a third reviewer.

RESULTS

Eight RCTs met the inclusion criteria (2019–2025). Study designs included double-blind (n=4), single-blind (n=1), and open-label (n=1) trials, with sample sizes ranging from 12 to 126 patients. Follow-up ranged from 24 weeks to 5 years.

Key Findings

- 7 of 8 RCTs reported SVF to be superior to the comparator in at least one primary outcome.
- Consistent improvements in VAS pain and WOMAC scores across studies.
- Several studies showed MRI evidence of cartilage preservation or regeneration.
- One study (Mautner 2023) found no superiority of SVF over corticosteroid at 12 months.

Safety

- No serious adverse events (SAEs) related to SVF injection across all 8 trials.
- Common AEs: mild knee pain/swelling and abdominal bruising at harvest site.
- All reported AEs were mild and self-limiting.

Study	Design	Comparator	Follow-up	Key Finding	Safety
Hong 2019	Double-blind, self-controlled	HA	12 mo	SVF superior (VAS, WOMAC, WOMRS, MOCART)	No SAEs
Garza 2020	Double-blind, placebo-controlled	Placebo	12 mo	SVF superior (WOMAC); dose-dependent effect	No SAEs
Zhang Y 2022	Double-blind RCT	HA	12 mo	SVF superior; cartilage regeneration on MRI	No SAEs
Zhang S 2022	Assessor-blinded RCT	HA	5 yr	SVF superior (VAS, WOMAC); longer response time	No AEs
Mautner 2023	Single-blind, multicenter	Corticosteroid	12 mo	SVF not superior to CSI	No SAEs
Tantuway 2023	Double-blind RCT	Saline	36 mo	SVF superior (KOOS, VAS)	No SAEs
Ren 2023	Open-label, self-controlled	No treatment	24 wk	SVF facilitated cartilage regeneration	No complications
Lu 2025	Double-blind RCT	Rehabilitation	12 mo	SVF superior (pain, stiffness, function)	No SAEs

CONCLUSIONS

1. The majority of RCTs (7/8) demonstrated that SVF injection provides clinically meaningful improvements in pain, function, and/or structural outcomes compared to conventional treatments.
2. SVF showed a favorable safety profile with no procedure-related SAEs reported across all included trials.
3. Heterogeneity in SVF preparation methods, cell doses, and comparator groups limits direct cross-study comparisons.
4. Larger, multicenter, long-term RCTs with standardized SVF protocols are needed to establish definitive efficacy and optimal dosing.