Table SI. Search strategy and key inclusion principles[a].

Database/source	Core search string or search concept	Date updated	Priority inclusion focus	Boundary/exclusion principle
PubMed	Osteosarcoma AND (bone niche OR bone microenvironment OR tumor microenvironment OR osteoimmunology) AND (immune failure OR immune suppression OR immunotherapy resistance)	April 2026	Human and experimental studies addressing OS immune microenvironment, skeletal niche, myeloid remodeling, immunotherapy resistance or pulmonary recurrence	Broad background papers were used only when OS-specific evidence was absent or incomplete
PubMed	Osteosarcoma AND (macrophage OR tumor-associated macrophage OR TAM OR myeloid-derived suppressor cell OR MDSC OR immune exclusion)	April 2026	Macrophage/myeloid biology, spatial immune organization, antigen presentation, T-cell dysfunction and therapeutic implications	Studies with only generic immune-score associations were treated as lower-tier evidence unless supported by functional or spatial data
PubMed/Web of Science	Osteosarcoma AND (efferocytosis OR MerTK OR MERTK OR AXL OR Gas6 OR PD-L1) AND (macrophage OR immune tolerance OR therapy-induced cell death)	April 2026	Evidence linking dying cell clearance, TAM reprogramming, PD-L1 induction, immune tolerance and post-treatment immune state	Pan-cancer TAM-receptor literature was treated as contextual evidence, not as direct OS proof
Web of Science/Scopus	Osteosarcoma AND (extracellular vesicle OR exosome OR EV OR premetastatic niche OR lung metastasis OR pulmonary recurrence)	April 2026	EV cargo, bone-lung communication, pulmonary premetastatic niche conditioning, gMDSC recruitment and lung recurrence mechanisms	EV cargo enrichment or recipient-cell inference was not considered sufficient to establish causality without perturbation or longitudinal validation
Web of Science/Scopus	Osteosarcoma AND (metabolism OR mitophagy OR GABARAP OR BNIP3 OR hypoxia OR UPR OR pyruvate) AND (immune OR antigen presentation OR T cell OR NK cell)	April 2026	Metabolic and physical stress adaptation, immune-recognition readouts, and tumor-ecology mechanisms relevant to the skeletal niche	Prognostic signatures and pathway-enrichment studies were classified as hypothesis-generating unless linked to functional immune readouts
Manual cross-checking	Reference lists of recent OS, tumor microenvironment, osteoimmunology, EV, premetastatic niche and immunotherapy reviews	April 2026	High-quality contextual reviews and translational studies needed to define evidence boundaries and validation priorities	Contextual evidence from broader tumor biology was explicitly separated from OS-specific evidence in the main text and tables

[a]The associated review was designed for conceptual synthesis rather than quantitative effect estimation; therefore, no pooled analysis or formal risk-of-bias scoring was performed. Search strings were adapted iteratively for database syntax. The final evidence hierarchy in the manuscript classified candidate mechanisms according to OS specificity, functional validation, spatial or longitudinal support, and translational relevance. This table is intended to improve transparency for a mechanistic narrative review and should not be interpreted as a PRISMA-style systematic review protocol. OS, osteosarcoma; Gas6, growth arrest-specific 6; MERTK, MER proto-oncogene tyrosine kinase; AXL, AXL receptor tyrosine kinase; TAM, tumor-associated macrophage; EV, extracellular vesicle; gMDSC, granulocytic myeloid-derived suppressor cell; NK, natural killer; UPR, unfolded protein response; PD-L1, programmed death-ligand 1; BNIP3, BCL2 interacting protein 3; GABARAP, GABA type A receptor-associated protein.