GALAXY INTERNATIONAL INTERDISCIPLINARY RESEARCH JOURNAL (GIIRJ)
ISSN (E): 2347-6915
Vol. 14, Issue 8 August (2026)

HISTORICAL DEVELOPMENT AND METHODOLOGICAL ASPECTS OF ANCIENT SCULPTURE RESTORATION IN UZBEKISTAN

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ABSTRACT

This article presents a comprehensive study of the historical development, methodological frameworks, and practical approaches to the restoration of ancient monumental and small-scale sculptures in Uzbekistan. Drawing upon archival expedition reports, laboratory documentation, and published conservation case studies, the paper examines material-specific treatments for stone, unfired and fired clay, and ganch (gypsum) sculptures. Key case studies – Jarqutan, Toprak-kala, Dalvarzintepa (Boddhisattva), Karatepe and Kuyavkurgan – illustrate the evolution from early field conservation methods to contemporary laboratory-based protocols involving polymer consolidation, vacuum impregnation, 3D documentation, and ethical considerations such as minimal intervention and reversibility. Recommendations are provided for strengthening national capacities, establishing standardized protocols, and fostering international collaboration to ensure the sustainable preservation of Uzbekistan's sculptural heritage.

Keywords: Restoration, conservation, ancient sculpture, clay, Uzbekistan, cultural heritage, archaeology, cleaning, polymer consolidation, Toprak-kala, Dalvarzintepa.

INTRODUCTION

The territory of present-day Uzbekistan comprises a dense stratigraphy of cultural encounters, state formations, and artistic production spanning Antiquity to the medieval period. Among the most valuable archaeological testimonies are sculptural works – from small terracotta figurines to monumental clay and stone statues – which provide insight into religious, social, and aesthetic practices of past societies. Sites such as Topraq Qala, Dalverzin Tepe, Kara-Tepe, Jarkutan and Kuyovqorgon have yielded notable sculptural ensembles that pose significant conservation challenges due to their material composition, in situ burial conditions, and long-term exposure to fluctuating environmental regimes. This study aims to outline a historical trajectory of restoration practices in Uzbekistan, analyze material-specific conservation methods, present detailed case studies, and offer practical recommendations for national heritage management. By situating local practice within international theoretical frameworks (ICOM-CC, Getty Conservation Institute), the paper underscores the need for scientifically informed, ethically responsible conservation strategies.

LITERATURE REVIEW

The academic foundation for understanding Central Asian sculpture and its conservation rests upon early archaeological publications and subsequent conservation reports. Tolstov's pioneering work (Tolstov, 1948) documented extensive finds in Khwarezm and highlighted the

precarious state of sculptural remains at excavation sites. Mid- and late-20th century Soviet scholarship, including Pugachenkova and Rempel (1965), expanded typological and stylistic frameworks for the region's visual culture. Conservation-focused literature in Uzbekistan emerged gradually: Reutova's chamber restoration studies (Reutova, 2020), Akhadova's chemical analyses (Akhadova, 1986), and Fedorovich's work on polymerization techniques (Fedorovich, 1995) provided practical protocols adapted to local materialities. International works – Sease (1994), Ambers (2004), and Getty publications – contributed methodological rigor and new technologies such as photogrammetry, FTIR/XRF analysis and conservation-grade polymers. Recent discourse in conservation ethics (ICOM-CC statements) emphasizes minimal intervention, reversibility, full documentation, and interdisciplinary collaboration – principles increasingly reflected in Uzbek practice during fieldwork and laboratory restoration projects in the last two decades.

MATERIALS AND METHODS

This study synthesizes primary archival sources (expedition fieldbooks, conservation logs), published monographs and articles, and direct laboratory protocols developed at the Institute of Art Studies (Tashkent). Comparative historical analysis traces chronological changes in field and laboratory procedures. The methodological approach categorizes interventions by material group (stone; fired and unfired clay; ganch/gypsum) and treatment type (field stabilization, consolidation, desalination, structural reinforcement, aesthetic reintegration). Where available, the study incorporates analytical data (XRF, FTIR, petrographic descriptions) from prior chemical studies conducted by Akhadova, Reutova and the Institute's laboratories. Case-study methodology is applied to prominent restoration projects (Dalvarzintepa Boddhisattva, Toprak- kala reliefs), reconstructing the decision-making process, materials chosen, and sequencing of treatments.

CASE STUDIES

Jarqutan: Early Clay Statuary and Chamber Treatment

Jarqutan (Surkhandarya region) has furnished small- to medium-sized clay statues exhibiting layered manufacture and organic temper. Excavated fragments often display stratified construction: an inner core of coarse clay and straw, followed by finer outer layers and surface gesso or thin gypsum layer for painting. Early interventions prioritized documentation and careful recovery, with chamber conservation by Reutova and colleagues involving mechanical cleaning, consolidation with low-viscosity acrylics, and selective reintegration of fragments. Notably, Reutova's protocol emphasized minimal mechanical cleaning to preserve pigment residues and production traces; consolidation tests on representative fragments guided selection of Paraloid B-72 concentrations for injections and surface coatings.

Toprak-kala: Monumental Reliefs and Salt-related Pathologies

Toprak-kala's monumental clay reliefs and statues present chronic deterioration driven by high soil salinity, capillary action, and repeated wetting-drying cycles. Tolstov documented numerous in situ finds and the early use of plaster jackets for transport; however, these practices sometimes introduced additional stresses or incompatible materials. Conservation

at Toprak-kala evolved toward desalination (poultices and controlled washing), controlled drying, and application of consolidants matched to the object's porosity. Detailed desalination protocols involve repeated poulticing (cellulose or clay-based) with monitoring of soluble salt levels, followed by graded drying under controlled humidity to avoid rapid shrinkage.

Table 1. Consolidation Materials and Concentration Ratios

Material Type	Consolidant	Solvent	Concentration	Application Method
Clay Sculpture	Paraloid B-72	Acetone	5–10%	Injection / Spray
Gypsum (Ganch)	PMMA	Butanol	10–15%	Vacuum Impregnation
Stone (Limestone)	Silicate Ester	Ethanol	15%	Brush / Capillary
Painted Surface	BMA (Butyl Methacrylate)	Acetone	5%	Micro-spray

These measures were standardized in Tashkent laboratories by the late 1970s and remain foundational in current Uzbek restoration practice.

Dalvarzintepa Boddhisattva: International Exhibition and Emergency Conservation

The Dalvarzintepa Boddhisattva (inv. FASI-0398) constitutes a complex composite: timber armature, textile wrapping, layered clay, gypsum finish and polychrome. Its restoration trajectory illustrates contemporary interdisciplinary practice. Initially conserved and stabilized in Tashkent, the sculpture underwent additional intervention for international loan and display (Berlin, 2023–2024). During installation, mechanical stresses induced vertical cracking and localized losses (noted in the right lower portion and posterior).

Emergency conservation included: temporary mechanical bracing; surface consolidation using 10% Paraloid B-72 in acetone injected into fissures; localized adhesive bonding with two-component epoxies where structural integrity demanded (used sparingly and documented); and protective packing for transport. After return, laboratory treatment involved removal of incompatible metal brackets and polyurethane foams, controlled mechanical cleaning, structural reinforcement with stainless steel threaded rods sheathed in PTFE, backfilling voids with compatible cellulose- and lime-based mastics where necessary, and final surface stabilization with reversible acrylic coatings. The intervention prioritized reversibility for future work and minimal aesthetic reintegration limited to gap compensation rather than conjectural reconstruction.

Post-treatment assessment included photographic documentation, condition mapping, and environmental monitoring recommendations for display and storage (stable RH range, UV-filtering light levels). The project demonstrated the importance of pre-exhibition risk assessment and tailored mounting solutions to avoid installation-related damage.

Karatepa and Kuyavkurgan: Monastic Ensembles and In-situ Stabilization

Karatepa and Kuyavkurgan yielded multi-figure assemblies, many of which remained in situ during early campaigns. The conservation approach here emphasizes minimal intervention and in situ stabilization when removal could cause greater harm. Techniques include local sheltering, temporary consolidation with cellulose ethers or dilute acrylics, and selective removal of the most vulnerable fragments for laboratory treatment. In situ monitoring,

photographic records, and periodic maintenance remain crucial at these open-air or partially-roofed contexts. Where removal was undertaken, packing protocols and custom crating with vibration dampening ensured safe transfer to laboratory facilities.

Table 2. Sequential Stages of Clay Sculpture Restoration

Stage	Procedure	Tools / Materials	Notes
1.	Documentation & Condition Mapping	Photography, 3D Scanning	Pre-treatment baseline
2.	Cleaning & Salt Testing	Brushes, distilled water	Controlled moisture
3.	Consolidation	Paraloid B-72, PMMA	Multiple cycles, reversible
4.	Structural Reinforcement	Fiberglass, stainless rods	Minimal load-bearing
5.	Gap Filling & Color Matching	Reversible mastics	Distinct tone for readability
6.	Final Coating & Labeling	UV-stable acrylic	Protective, non-glossy

RESTORATION TECHNIQUES AND PROTOCOLS

MATERIAL-SPECIFIC STRATEGIES

Conservation strategies must reflect the object's material system. For stone, emphasis is placed on low-impact cleaning, desalination (if required), consolidation with silicic or acrylic consolidants matched to porosity, and non-invasive stabilizing pinning where necessary. For fired and unfired clay, consolidation depth is critical: low-viscosity monomers (Paraloid B-72, PMMA) and butyl methacrylate (BMA) are used with controlled impregnation. For ganch and gypsum-based modeling, soluble salts and hygroscopic behaviour necessitate strict humidity control and reversible fills.

Consolidation and Impregnation

Vacuum impregnation enhances penetrative depth of consolidants, particularly for porous unfired clay. The procedure requires pre-testing to determine uptake, using graded concentrations to avoid surface film formation that hinders vapor diffusion. Thermal-assisted polymerization may be considered with caution to avoid stresses. Documentation of concentration, cycles and curing conditions is mandatory for future reversibility evaluation.

Desalination, Cleaning and Pigment Preservation

Desalination protocols combine poultices, controlled rinsing, and ion-exchange resins in extreme cases. Surface cleaning prioritizes dry methods first (brushes, soft vacuums), followed by aqueous gels or emulsions designed to limit solvent migration. Pigment preservation benefits from minimal wet treatments and localized consolidation prior to cleaning to secure loose paint layers.

Structural Repair and Mounting

Structural repairs favor reversible mechanical systems: stainless steel or titanium pins with inert sleeves (PTFE), non-shrink compatible fillers, and external mounts designed to

distribute load away from fragile joins. Mounting systems for display should enable easy removal and monitoring, using seismic safety features where relevant for loaned objects.

Ethics, Documentation and Long-term Care

Restorers operate within an ethical framework that privileges authenticity, reversibility and thorough documentation. All interventions must be recorded: condition maps, photographic sequences, materials logs (with batch and concentration data), and treatment rationale. Restoration decisions should be reviewed by interdisciplinary committees comprising archaeologists, conservators, chemists and curators. Long-term care plans – including environmental control specifications, handling protocols, and periodic condition assessments – are essential. Education and capacity building for local conservators, as well as community engagement, help ensure sustainable stewardship. Clear labeling of past interventions and provision of a conservation file with each object supports transparency.

RECOMMENDATIONS

Based on historical patterns and contemporary case studies, the following recommendations are proposed for national conservation strategy:

1. Analytical Capacity: Invest in routine access to FTIR, XRF, microscopy and micro-sampling facilities to inform material-specific strategies.
2. Standardized Protocols: Develop national guidelines for field stabilization, desalination, impregnation concentrations, and reversible fills calibrated to local materials.
3. Emergency Preparedness: Equip excavation teams with standardized emergency stabilization kits (consolidants, plaster bandages, packing materials) and protocols for loaned objects.
4. Documentation and Digital Records: Implement mandatory photogrammetry and 3D scanning for significant finds prior to treatment; maintain open-access conservation databases for research and transparency.
5. International Collaboration and Training: Foster partnerships with institutions (Getty, British Museum, ICOM-CC) for workshops and fellowships to update skills and adopt best practices.
6. Public Outreach: Integrate conservation narratives into museum displays to raise awareness about the complexities and ethical bases of restoration work.

CONCLUSION

The development of restoration practice in Uzbekistan mirrors global shifts in conservation: from empirical field measures toward scientifically informed, ethical, and interdisciplinary approaches. Material science, improved documentation techniques, and ethical standards have enabled treatments that respect original fabric while allowing for research and public display. Nevertheless, ongoing investment in analytical laboratories, standardized national protocols, and international cooperation is required to address persistent challenges such as saline soils, climatic variability, and risks associated with loans and display. By building institutional capacity and adopting the recommendations set out above, Uzbekistan can

consolidate its role as a custodian of Central Asian sculptural heritage and contribute valuable case studies to the international conservation community.

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