

The Technical and Ethical Foundations of Islamic Surgery in Global Medical Heritage

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Abstract

The Islamic Golden Age (8th–16th centuries) was a significant time for surgical research because it brought together technological precision, moral obligation, and empirical observation. More than 200 procedures and tools, including cataract extraction, cauterisation, and lithotomy, were described in the 30-volume surgical text Al-Zahrawi's Al-Tasrif (c. 1000 CE), which was translated into Latin in the 12th century [1,3]. Despite influencing European surgical education for centuries, Islamic contributions remain underrepresented in modern surgical historiography [2,5].

Methodology: This multidisciplinary study combined historical textual analysis, archaeological artifact evaluation, and digital thematic mapping using NVivo 14 [2,3,6]. Primary sources included Al-Tasrif, Canon of Medicine, Kitab al-Hawi, and Book of Optics [1,2,3,4,6,10,17]. Artifacts, such as Abbasid-era surgical tools and glassware, were examined for design continuity with textual descriptions [5,13–16,18–22]. Inclusion criteria prioritised authenticated sources; non-scholarly interpretations were excluded.

Results: Thematic analysis revealed a technical emphasis on specialised tools for fracture management, wound care, and pharmacological standardisation [1,3,4,6]. Al-Razi's protocols for boiling instruments and myrrh-based antisepsis [2,4,9] prefigure modern sterilisation. Ibn Sina's opium-mandrake sedation formulas [4,6] align with biopsychosocial anaesthesia ethics [4,10]. Textual and archaeological parallels indicate technological continuity, though material evidence remains partial [5,13–22]. Empirical optics guided ophthalmic instrument design [17]. Ethical frameworks, including rida (informed consent) and holistic care in bimaristans, anticipated modern medical ethics and patient-centred care models [2,5,10]. **Conclusion:** Islamic surgical traditions combined technical innovation with ethical integrity, providing a foundation for surgical ethics, AI integration, and global health equity [7,11]. Recommendations include integrating classical texts into medical curricula and investigating Unani antimicrobial agents for surgical use [9,10,12].

Introduction

During the Islamic Golden Age (8th–16th centuries), surgical knowledge advanced due to a mix of anatomical correctness, empirical observation, and a strongly

engrained ethical framework. Al-Tasrif, a 30-volume encyclopedia authored by the Andalusian physician-surgeon Al-Zahrawi in 1000 CE, is critical to this legacy [1]. Al-Tasrif, which was translated into Latin in the 12th century, became a fundamental part of surgical education

in Europe for centuries. It codified more than 200 surgical methods and instruments, including cataract extraction, cauterization, and lithotomy [1,3]. A wider Islamic paradigm that combined scientific precision with ethical responsibility in medical practice is further demonstrated by the contributions made to antisepsis, pharmacology, and basic anesthesia by academics such as Al-Razi and Ibn Sina [2,4].

Despite their impact, contributions of Islamic surgery are routinely disregarded in popular surgical historiography [2, 5]. The underrepresentation of Islamic contributions restricts our current understanding of surgical ethics, holistic care, and interdisciplinary practice in medical advances, in addition to being an academic oversight.

This essay seeks to correct that imbalance by delving into the technical and ethical basis of Islamic surgery. It specifically analyzes source texts such as Al-Tasrif, Canon of Medicine, and Kitab al-Hawi using qualitative thematic analysis, reinforced by archaeological objects (e.g., Abbasid-era surgical tools) and modern bioethical discourse [1,2,3,4,5,13,14,18-22]. The study employs both traditional content and digital approaches (NVivo 14 autocoding), recognizing that such technologies complement, rather than replace, critical textual and historical interpretation. This combination approach enables the formation of patterns in clinical instruments, antiseptic regimen, pharmaceutical accuracy, and biopsychosocial ethics.

The discussion will focus on four key domains: (1) instrumentation and operative methods, (2) antisepsis and anaesthesia, (3) ethical principles such as rida (informed consent), and (4) the historical contributions' relevance to today's debates on robotic surgery, AI-driven healthcare, and global surgical equity [7,11]. By drawing a connection from medieval surgical manuscripts to modern technical ethics, the essay demonstrates how Islamic medical traditions can enrich—rather than simply precede—modern surgical practice.

Methodology

This study applies a multidisciplinary qualitative methodology to examine the technical and ethical contributions of Islamic surgical practice. It synthesises historical textual analysis, archaeological artifact evaluation (prioritising artifacts featured in the accompanying poster presentation), and digital thematic mapping using NVivo 14 [2,3,6]. The purpose is to determine how Medieval Islamic surgical books and practices influenced the formation of global surgical

standards, particularly in instrumentation, asepsis, anaesthesia, and medical ethics.

Primary Sources

Four foundational medical texts were selected:

- Al-Zahrawi's Kitab al-Tasrif (c. 1000 CE) – for operative procedures, tools, and surgical classifications [1,3];
- Ibn Sina's Canon of Medicine (especially Books I & V) – for its pharmacological formulas, sedation practices, and ethical reasoning [4,6];
- Al-Razi's Kitab al-Hawi and Kitab Tibb al-Ruhani – for early antiseptic measures and biopsychosocial models of care [2,10];
- Ibn al-Haytham's Book of Optics – for its empirical optical principles relevant to ophthalmic surgical instrument design [17].

These texts were processed through NVivo 14's autocoding function, which extracted dominant themes using word frequency and semantic clustering algorithms [2,3,6,17]. No manual coding was used to preserve analytical neutrality and allow emergent, rather than imposed, themes. Thematic treemaps revealed:

- Al-Tasrif: frequent emphasis on "surgery," "instrument," "fracture," and "wound" [1,3];
- Canon of Medicine: dominant terms included "organs," "cause," "bone," "suture," and "medicine" [4,6];
- Optics by Ibn al-Haytham: recurring terms such as "light," "refraction," "form," and "eye," reflecting the empirical geometry underpinning medieval ophthalmology and the design of vision-related surgical instruments [17].

Archaeological Parallels: In addition to textual analysis, a targeted search for visual and material artifacts was undertaken. Priority was given to museum-grade items, authenticated archaeological finds, and illustrative reconstructions featured in the accompanying poster presentation. Recognising limitations in provenance for certain items, these materials were included to support visual comparison with surgical instruments and therapeutic tools described in primary Islamic medical texts [13,14,15,16,18-22].

Inclusion and Exclusion Criteria: Included: Digitised, thematically analyzable classical Islamic texts (8th–16th c.); peer-reviewed secondary literature; validated museum-grade artifacts, prioritising those featured in the poster presentation; WHO and global health ethics sources [7,11,12]. Excluded: Non-scholarly or pseudohistorical interpretations; undigitized manuscripts not suitable for digital analysis; texts outside Islamic medical traditions unless directly comparative.

Results

A. Instrumentation Innovation

Al-Tasrif catalogued over 200 surgical tools, including ratcheted forceps (proto-hemostats) and catgut sutures (absorbable ligatures) [3,5]. Thematic analysis using NVivo 14 revealed high-frequency clusters around "surgery," "instrument," "fracture," and "wound" [1,3]. Archaeological parallels support, though do not definitively prove, the operational use of these instruments. Abbasid-era surgical tools displayed in curated exhibitions demonstrate strong design similarity to instruments illustrated in Al-Tasrif, including scalpels, tooth removers, tongue depressors, and alembics for medical distillation [13,14,18–22]. Comparative analysis of surgical instruments recovered from Andalusian sites suggests technological continuity between textual descriptions and surviving material culture [5].

B. Antisepsis and Aseptic Protocols

Al-Razi's *Kitab al-Hawi* prescribed boiling instruments (proto-autoclaving) and wound irrigation with 4–8% acetic acid (vinegar) and Commiphora myrrha (myrrh), whose sesquiterpene terpenoids demonstrated bactericidal activity (MIC: 0.5 mg/mL) [2,4,9]. Al-Zahrawi similarly detailed the use of sterilised cloth and herbal sponges during surgical procedures [1,3]. While no antiseptic-specific artifacts have been recovered, surgical tools consistent with these descriptions and modern pharmacological studies on al-murr's antimicrobial properties provide supporting evidence [9,13,18–20].

C. Anaesthesia and Pharmacological Control

Ibn Sina's *Canon* standardised preoperative sedation using opium (*Papaver somniferum* latex) and mandrake (*Mandragora officinarum* root) tinctures in a 1:3 ratio, titrated to patient weight (50–70 kg) [4]. NVivo clustering around "organs," "cause," "bone," "suture," and "medicine" reflects the integration of pharmacology

and surgery [4,6]. Abbasid-era ceramic jars consistent with medicinal opium storage provide partial material corroboration [4,5]. These protocols align conceptually with modern pharmacology, including informed sedation based on mental and spiritual readiness [4,9,10].

D. Visual Science and Surgical Instrument Design

NVivo analysis of Ibn al-Haytham's *Optics* revealed themes of "light," "refraction," "form," and "eye" [17]. These align with historical evidence that optical science informed ophthalmic surgical tool design during the Islamic Golden Age. Though no surviving optical instruments have been conclusively identified, textual and conceptual evidence support applied optics in surgical innovation [17].

E. Patient Autonomy and Informed Consent

Al-Razi's *Kitab Tibb al-Ruhani* emphasised psychological readiness and voluntary agreement (*rida*) [2,10]. NVivo analysis revealed no consent-specific clusters, reflecting the conceptual rather than terminological nature of this principle. These historical articulations of patient autonomy prefigure modern informed consent frameworks [7,11]. Ibn Sina also advocated for ethical agency in clinical decision-making [4,10].

F. Holistic Care in Bimaristans

Bimaristans institutionalised integrated surgical, psychiatric, and spiritual care [2,5,10]. NVivo findings revealed no direct bimaristan references, consistent with their institution-level rather than procedural focus. Archaeological finds of glass vessels, alembics, and cupping tools demonstrate design continuity with humoral therapy practices, though clinical application within bimaristans remains inferred [13,15,16,18–22].

G. Modern Ethical Relevance

Historical principles of personalised care, informed consent, and holistic healing remain relevant to modern medical debates. WHO guidelines on culturally responsive consent, health equity, and AI-assisted surgery echo priorities articulated in classical Islamic medical ethics [7,8,11].

Discussion

A. Legacy in Robotic and AI Surgery

Islamic surgical precision and systematisation resonate with modern robotic surgery [1,3,5]. Yet, ethical gaps remain as automation risks depersonalising care [7,11]. WHO guidelines emphasise culturally responsive consent, echoing Islamic ethical precedents [7]. Ibn Sina's tailored pharmacology prefigures ethically calibrated AI-driven care [4,6].

B. Recommendations for Integration

Incorporate Islamic texts into medical ethics curricula [2,10]; investigate myrrh's antimicrobial properties for surgical materials [9,10]; apply Islamic egalitarian care models to global health equity initiatives [11,12].

Conclusion

Islamic surgical traditions demonstrate technical foresight and ethical robustness [1,2,4,5,6]. Al-Tasrif and KitabTibb al-Ruhani emphasised precision, antisepsis, and informed consent centuries before modern codification [1,2,4,10]. Despite marginalisation in historiography, their legacy informs global surgical ethics and AI integration [7,11]. Rediscovery and curricular integration can harmonise technological excellence with moral accountability [2,10,11,12].

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Appendix I — NVivo 14 Treemap Visualisations

Treemap 1 — Kitāb al-Taṣrīf (Al-Zahrawi)



Treemap 2 — Kitāb al-Manāzir (Ibn al-Haytham)



seed plantain seed lettuce seed	seed fennel seed bugle seed	seed celandine seed dil...
poppy yellow poppy white poppy	poppy poppy oil poppy bark	
element water element remaining elements	element earth element several chemica...	element differe... light ...
great great complexity past greatness	great great sage great dist...	great grea... gre... grea... great ... great o...
water water element water sign	water warm water hot water	water cold wat... pure water
following following medi...	following faithful follower following descrip...	following follow... foll... fo... fo... fol...
causes primitive ... final causes	causes ultimat... conjo...	causes formal ... cause...
work literary work laboratory work	work ancient w... volu...	work hospital work gold ...
bodily bodily ... bodily or...	bodily bod... bodi...	sign windy sign water sign
nature essential ... distinctive nature	human primary q...	qualities tactile... heat...
serous humour serous humour sweet ...	belief religious ... ligious ... private ... pious be...	movement bodily ... new-t...
functional functional conform... functional capacity	power pugilistic p... healing p...	medicine ancient me... arabian me...
science islamic science hermetic science	medical... positi...	ray solar r... incom...
earth earth element terrestrial earth	form physical form diffe...	modern thought modern thought chironia ulcer
organs internal orga...	bodily organs certain organs	ulcer treated ... telephic...
knowledge real knowl... intimate k...	inc... int...	substance physical sub... brain...
philosophy thomistic ... scholastic ...	process opposite p... actual pro...	lines stereot... equi...
empire saracen ... arabian ...	state bodily s... waking s...	finger finger ... sta...

Appendix II Tables/ Figures illustrated in the poster

Table 1 Study design

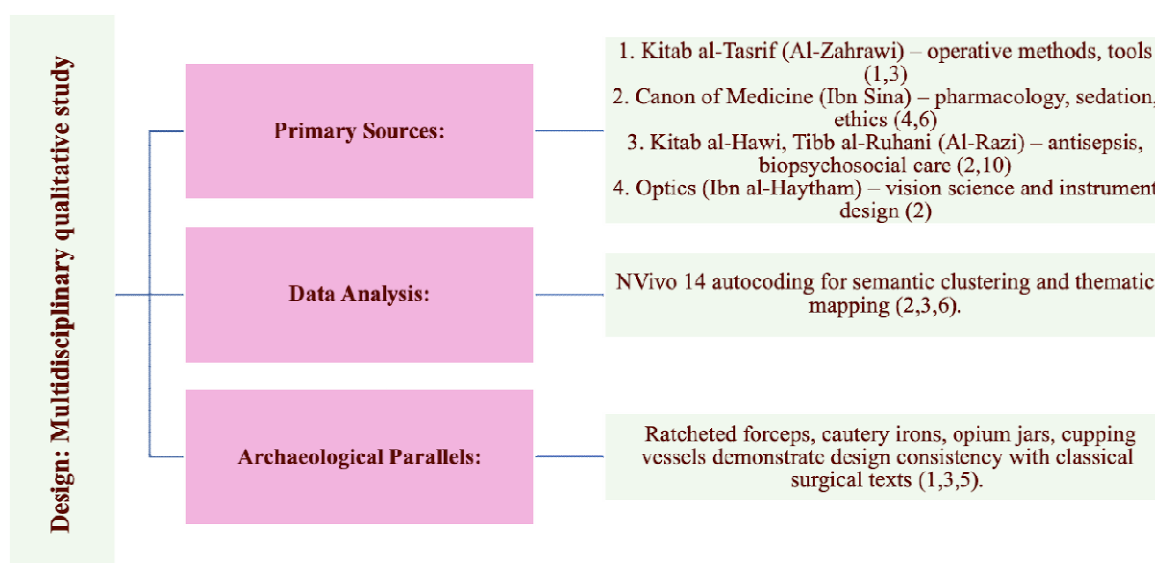


Table 2: Results - Technical contribution

Sub-Section	NVivo - Treemap	Manual Textual Interpretation	Archaeological Parallels	Other Studies (Indicative, not Definitive)
Instrumentation Innovation	surgery, instrument, fracture, wound (1,3)	Emphasis on specialised tools for fracture management and wound care in Al-Tasrif (1,3)	Ratcheted forceps and bone levers show design similarity to described tools (1,3,5)	Instruments from Andalusian sites share similar properties to textual descriptions (5)
Antisepsis & Asepsis	NA	Systematic antisepsis protocols using heat, acid, and herbal agents, including al-murr (المُر) (2,4)	No antiseptic artifacts recovered; archaeological context suggests parallels	Modern studies show al-murr has antimicrobial properties comparable to historical use (9)
Anesthesia & Pharmacological Control	organs, cause, bone, suture, medicine (4,6)	Sedative practices described using opium and mandrake, tailored to patient constitution (4,6)	No antiseptic artifacts recovered	Sedative protocols share similar dosage logic to modern principles (4,6)
Visual Science & Instrument Design	light, refraction, form, eye (2)	Empirical optical knowledge applied to surgical instruments for ophthalmology (2)	No confirmed optical instruments; textual evidence aligns with applied optics	Optical science conceptually influenced instrument design, though direct lineage not proven (2)

Table 3: Results - Ethical Foundations

Sub-Section	NVivo - Treemap	Manual Textual Interpretation	Archaeological Parallels	Other Studies (Indicative, not Definitive)
Patient Autonomy & Consent (rida, رضا)	NA	Emphasis on patient psychological readiness and voluntary agreement (rida, رضا) (2,10)	No material indicators; concept derived from textual sources	WHO consent frameworks share conceptual similarities, though distinct origins (7,8,11)
Holistic Care in bimaristans, بیمارستانات	NA	Integrated surgical, psychiatric, and spiritual care institutionalised in bimaristans (بیمارستانات) (2,5)	Glass cupping vessels share design similarities with those linked to humoral therapies; use in bimaristans remains consistent but unproven	Integrated care models show broad similarities, contexts differ (2,5,11)
Modern Ethical Relevance	NA	Principles of personalised care and consent (2,4,6)	N/A	WHO health equity and AI ethics debates echo related priorities (7,8,11)

Fig 1: 10th-century instruments from Kitāb al-Taṣrīf [3]

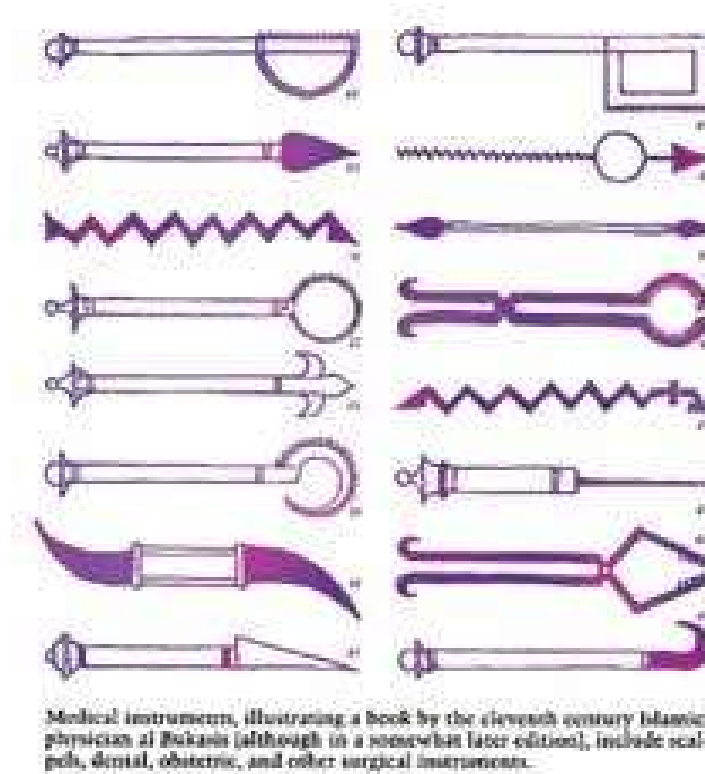


Fig 2: Abbasid-era surgical tools display [14]



Fig 3: Sold in auction listed as Ancient Islamic Glass Alembic for Medical Cupping [15]



Fig 4: Physician's cupping glass, or alembic, 9th–11th century. Iran, Nishapur [16]



Fig 5: Cast copper Abbasid-era Surgical Tools

Fig 5a: Tooth removal implement [23]

Fig 5b: Tongue depressor [24]

Fig 5c: Surgical scalpel [25]



Fig 6: Jabir ibn Hayyan distillation apparatus [20]



Fig7: Medieval distillation apparatus in La Granja [21]

