1.2. Chronological development of surgery from ancient to present era

Chronological Development of Surgery – From Pre-history to the Present

Era	Landmarks & Innovators	Knowledge/Technique Gained	Why it Mattered
Pre-historic (≈ 10 000 – 3000 BCE)	Trepanation holes in Neolithic skulls on every continent	Earliest proof that humans could open bone, recognise survival signs, and control bleeding	Demonstrates innate surgical impulse; survival rates ≈ 40 %
Early Civilisations (c. 2600 – 600 BCE)	• Edwin-Smith Papyrus, Egypt (≈ 1600 BCE) – 48 case-notes on head & spine trauma • इह खलु शल्यं प्रथमम् — Suśruta (~600 BCE) – 125 **śastra**, 120 **yantra**, detailed rhinoplasty flap: ⍰⍰⍰⍰⍰⍰⍰⍰⍰⍰ (Su. Su. 26), six-fold wound classification (Su. Sū. 1/12)	Systematic operative science; anaesthetic wine-henbane mix; aseptic wound care	Becomes the classical bed-rock of **Śalya Tantra** and plastic surgery
Greco-Roman (400 BCE – 500 CE)	Hippocrates on fracture traction; Celsus' ligatures & trepan; Galen's vascular dogma	Anatomy from animal dissection, arterial vs. venous bleeding control	Medical language of Europe; preserved by Arabs
Islamic Golden Age (7–11 th c.)	Abū al-Qāsim al-Zahrāwī *(Al-Zahrawi)*: **Kitāb al-Taṣrīf** – 200+ instruments, obstetric forceps, dental drills	Illustrated operative manual; silk-thread ligatures	Filters Greek–Indian surgery to medieval Europe
European Renaissance (14–18 th c.)	• Ambroise Paré (1510-90): gentle *ligature* replaces cautery • Andreas Vesalius (1543): *De Humani Corporis Fabrica* – human dissection atlas	Scientific anatomy; battlefield haemostasis	Lays foundation for rational, anatomy-based surgery
19 th-century Revolutions	*Pain ↦ Infection ↦ Imaging* triad • Ether anaesthesia (16 Oct 1846, Boston) • Carbolic-acid antisepsis (Lister, 1867) • X-rays discovered by Röntgen (1895)	Painless, infection-controlled, image-guided operations	Drops mortality, permits deep cavity & bone surgery
Early 20 th century	• ABO blood-groups (Landsteiner, 1901) • Antibiotics (Penicillin 1928) • First heart-lung machines & tumour resections • First kidney transplant (Boston, 1954)	Safe transfusion, infection control, major resections	Enables lengthy, complex operations
Transplant & Tech Era (1950-80s)	• Microsurgery & operating microscopes (1960s) • CT imaging (1971) • First laparoscopic cholecystectomy (Mühe, 1985)	Organ replacement, minimally invasive optics	Surgery shifts from "large incision, large cure" to key-hole precision
Robotic & Digital Age (2000 →)	• da Vinci system FDA-cleared (2000) • First complete tele-surgery "Lindbergh Operation" (2001) • 5G ultra-remote telesurgery feats (Rome-Beijing prostatectomy 2024)	Enhanced dexterity, tremor-filter, distance-nullifying care	Opens door to AI-assisted, mixed-reality and nano-robotic interventions
Frontiers (2020s-present)	Xenotransplantation (pig-to-human heart, 2022); bioprinted tissues; autonomous suturing algorithms	Regenerative, personalised, data-driven surgery	Aims for scar-less, complication-free, globally accessible operations

Key Themes across the Timeline

1. **Control of Three Core Problems**
   Pain → *Bleeding* → *Infection* have sequentially been conquered (anaesthesia, ligature/blood-banks, antisepsis/antibiotics).
2. **Miniaturisation & Visualisation**
   From Sushruta's fine-pointed *vrihimukha śastra* to fibre-optics, laparoscopy, and 8 K 3-D robotic consoles.
3. **Integration of Technology**
   Imaging (X-ray, CT, MRI), digital planning, 3-D printing, and AI now fuse with operative skill—realising Suśruta's dictum: ▯▯▯▯▯▯▯▯▯▯▯▯▯ ▯▯▯▯▯▯▯▯ ▯▯▯▯▯▯▯ – "What is visible should be acted upon with the right instrument."

Mnemonic – "S-C-A-L-P-E-L" to remember the march of surgery

Letter	Epoch
S	**Stone-Age** trepanation
C	**Classical** Suśruta & Celsus
A	**Arabic** Al-Zahrawi
L	**Ligature** Paré & **Lister** antisepsis
P	**Pain-free** ether anaesthesia
E	**Electro-imaging** (X-ray → CT)
L	**Laparoscopy → da Vinci** & beyond

Take-Away

The chronicle shows a **continuous quest to remove "śalya" — anything that obstructs life**. Whether with a flint scraper, hemp-wine anaesthetic, or 5G robot, the surgeon's aim echoes Suśruta's ideal: "▯▯▯ ▯▯▯▯▯▯▯▯▯▯▯▯ ▯▯▯ ▯▯▯▯" – perform the act so that pain and pathology are both pacified. Knowing this lineage equips modern BAMS learners to integrate classical principles with today's technological frontiers—carrying forward an unbroken surgical heritage spanning ten millennia.