Fabrics

- Use of fabrics and other fibrous forms as biomaterial dates back to the early Egyptians and Indians:
  - Linen sutures and strips (Egyptians) to draw edges of wounds together for proper healing.

- Textile fabrics of woven, non-woven and knitted types have been used in one or more bio-medical application.
- Cellulose fibers from cotten or wood are the natural fibers most commonly used in the production of biomedical fabrics.

Courtesy R. Zenz

Fabrics

- Natural and synthetic fibers can be converted to different forms and fabric constructions:
  - Woven fabrics: usually low elongation and high breaking strength.
  - Knitted structures: superior elastic recovery and good wrinkle and crush resistance.
  - Needle felts: poor mechanical properties; used primarily as insulators ar for liquid absorption:
    - Diapers
    - Sanitary napkins
    - Gauze
    - Bandages

Courtesy R. Zenz

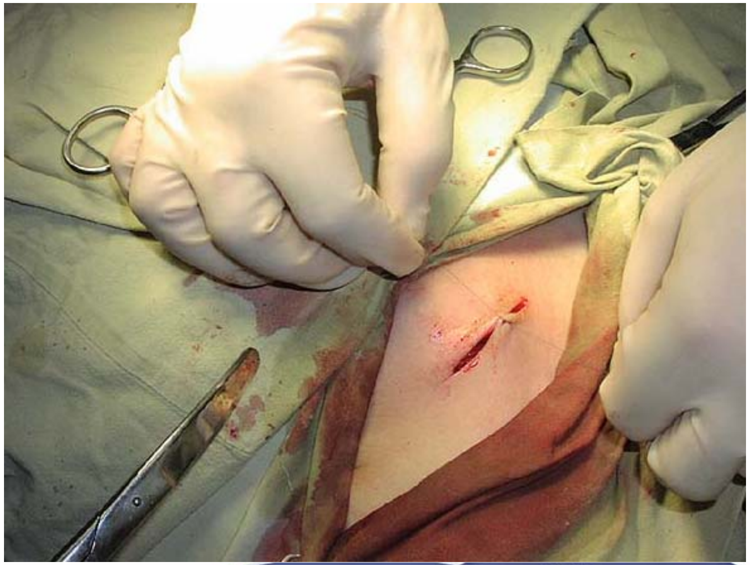
Fabrics

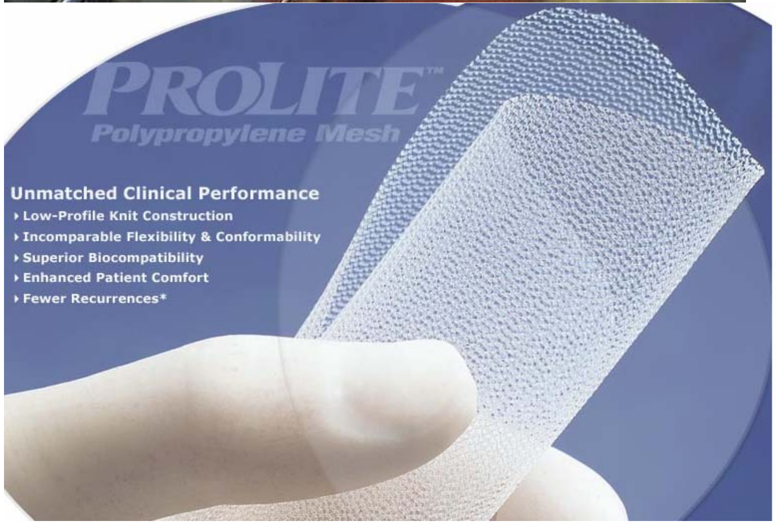
- Major biomedical applications:
  - Surgical gowns: mostly woven an non-woven cellulose, polyethylene and poly-propylen fibers.
  - Masks and shoe covers: made of gauze and nonwoven fabrics, respectively.
  - Adhesive tapes: woven or knitted fabric strip with adhesive film.

Courtesy R. Zenz

Fabrics

- Wound repair and reconstruction of soft tissue.
  - Sutures and threads used to close wounds.
  - Ligation threads to tie off bleeding vessels.
  - Fiber or fabric reinforced implants for reconstructive and repair surgery of soft tissues.

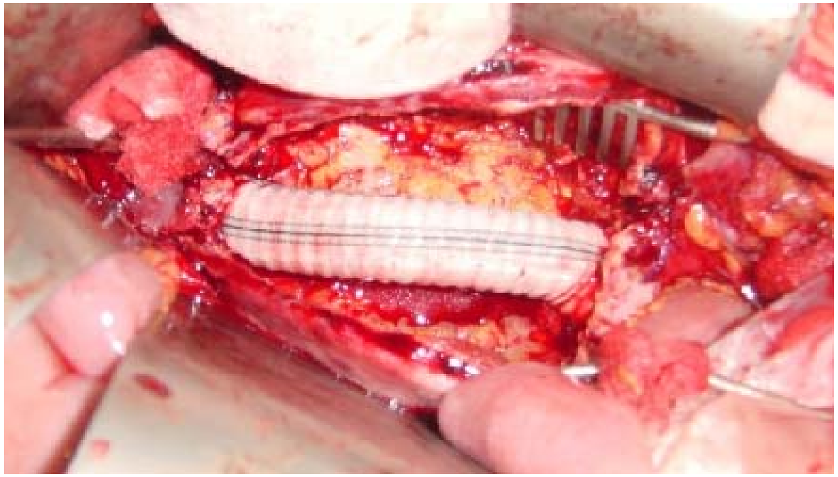




Courtesy R. Zenz

Fabrics

- Cardiovascular system applications:
  - Vascular grafts made of woven, knitted or micro-porous constructions.



Aortic aneurysm repair with Dacron graft

  - Dacron, Teflon, nylon66 and polypropylene have been used in prosthetic heart valves as „sewing ring“.

Courtesy R. Zenz

Fabrics

- Musculoskeletal system applications:
  - Artificial tendons and ligaments.
  - Matrices for reconstructive and maxillofacial surgery.
  - Graphite-Teflon fibers meshes as matrices for tissue ingrowth in stabilization of dental or orthopedic implants.

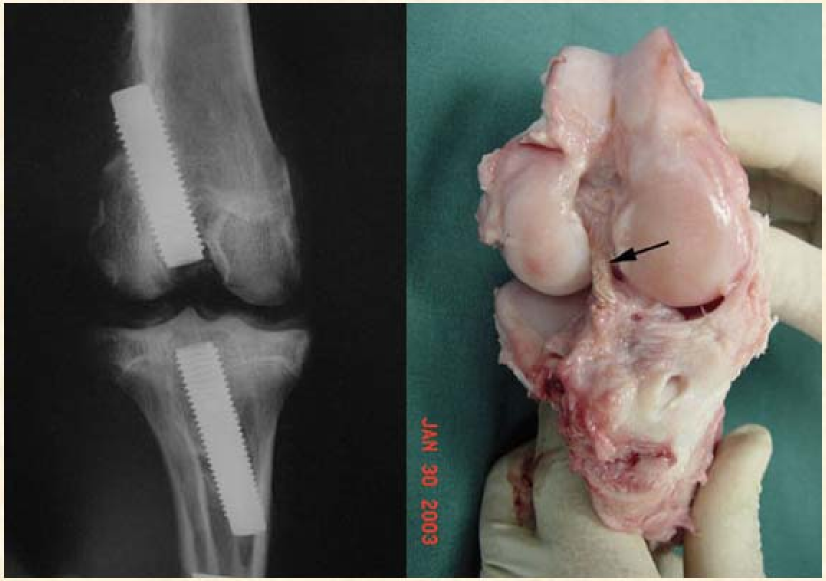


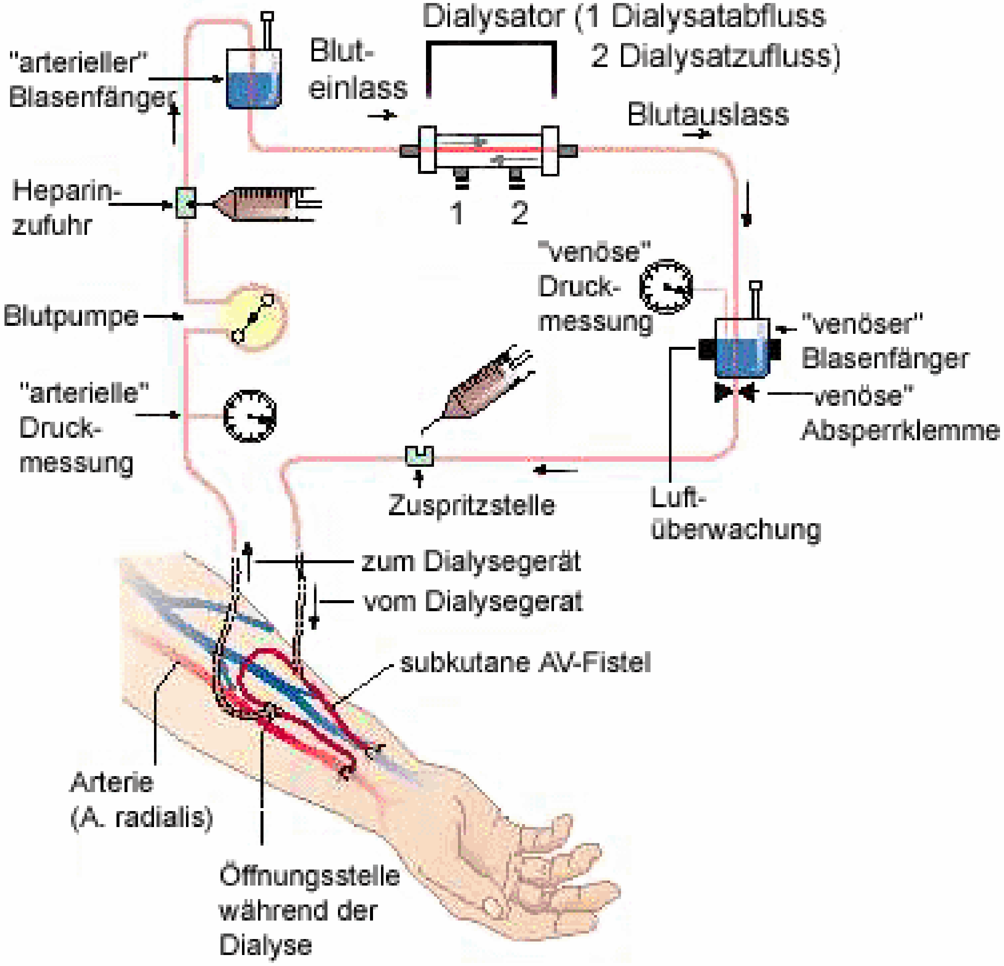
Figure 2. Ligament anchors and an artificial ligament were implanted in goat femur and tibia.

Courtesy R. Zenz

Fabrics

- Percutaneous and cutaneous application:
  - Artificial skin:

  - Shunts: to provide access to the circulation for routine dialysis.



Courtesy R. Zenz

Biologically Functional Materials

- Enzymes, antibodies, drugs, or cells have been immobilized on and with polymeric systems for a wide range of therapeutic, diagnostic and bioprocess applications.

- Many different molecules can be chemically or physically immobilized on polymeric supports.

TABLE 2 Applications of Immobilized Biomolecules and Cells

Enzymes	Bioreactors (industrial, biomedical) Bioseparations Biosensors Diagnostic assays Biocompatible surfaces
Antibodies, peptides, and other affinity molecules	Biosensors Diagnostic assays Affinity separations Targeted drug delivery Cell culture
Drugs	Thrombo-resistant surfaces Drug delivery systems
Lipids	Thrombo-resistant surfaces Albuminated surfaces
Nucleic acid derivatives and nucleotides	DNA probes Gene Therapy
Cells	Bioreactors (industrial) Bioartificial organs Biosensors

Courtesy R. Zenz

Biologically Functional Materials

- Immobilization methods:
  - Temporary (drug delivery)
  - Permanent (e.g. Artificial organ)

- 3 major methods:
  - Adsorption
  - Entrapment
  - Chemical

TABLE 6 Biomolecule Immobilization Methods

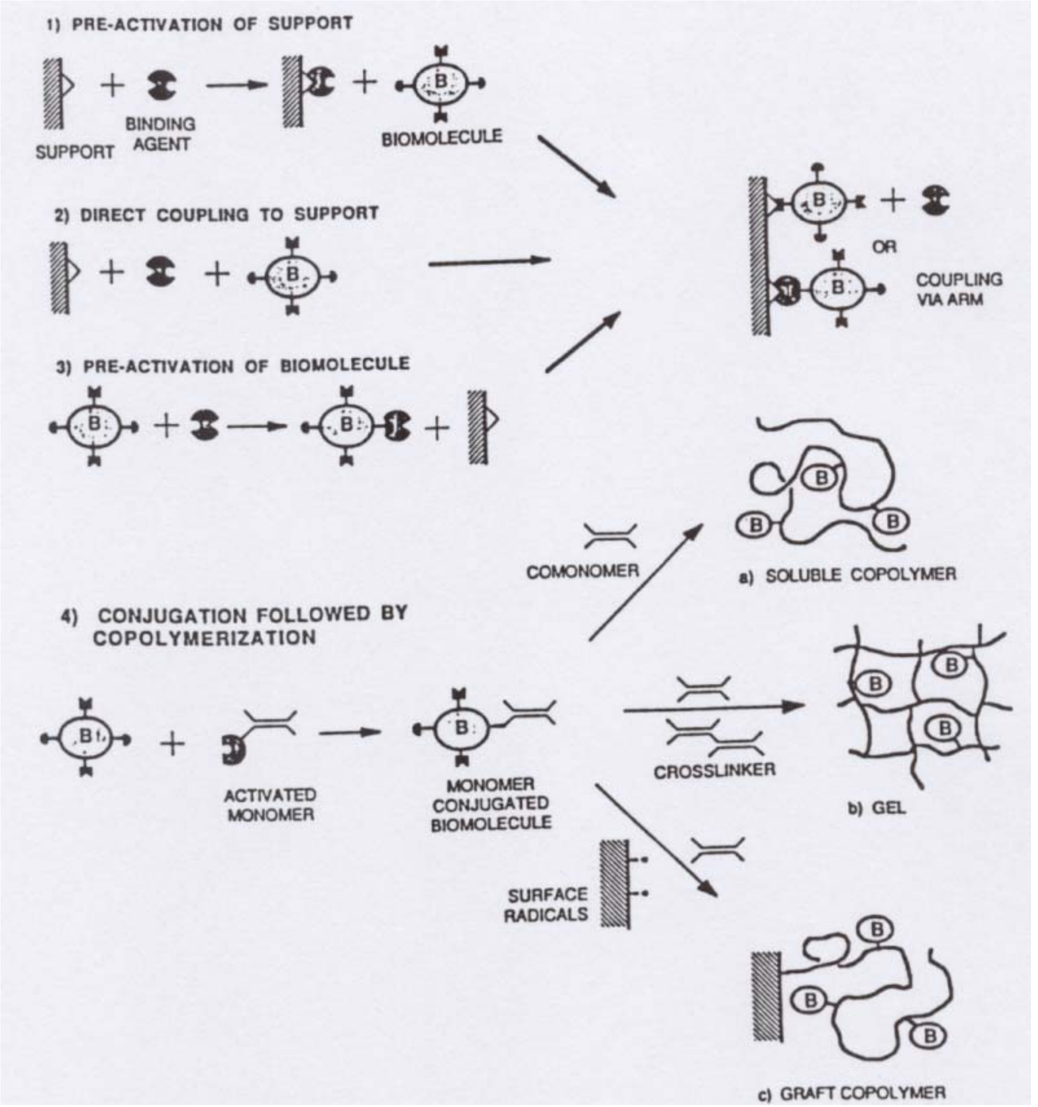
Physical adsorption
van der Waals
Electrostatic
Affinity
Adsorbed and cross-linked
Physical "entrapment"
Barrier systems
Hydrogels
Dispersed (matrix) systems
Covalent attachment
Soluble polymer conjugates
Solid surfaces
Hydrogels

Courtesy R. Zenz

Biologically Functional Materials

For covalent bonding to an inert solid polymer surface, the surface must first be chemically modified to provide reactive groups:

- OH
- N_2H
- COOH



Courtesy R. Zenz