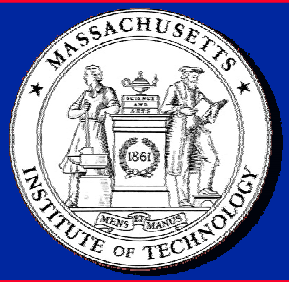
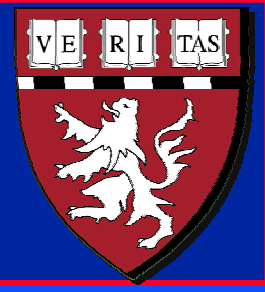


Massachusetts Institute of Technology
Harvard Medical School
Brigham and Women's Hospital
VA Boston Healthcare System



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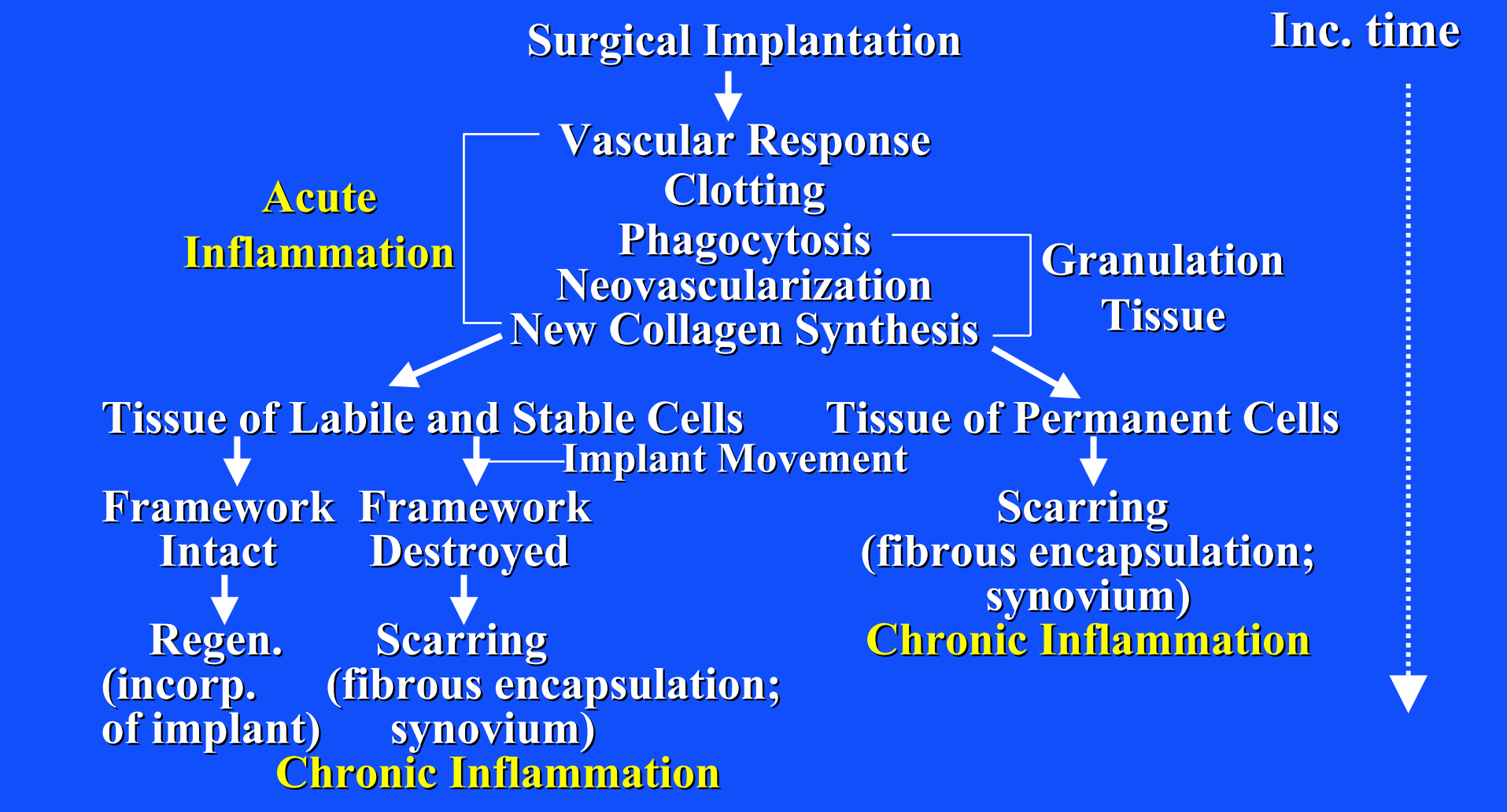
FORMATION OF SOFT TISSUE AND BONE AROUND IMPLANTS: The Chronic Response to Implants

I.V. Yannas, Ph.D. and M. Spector, Ph.D.

RESPONSE TO IMPLANTS: WOUND HEALING



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I. Metchnikoff

In 1923 a piece of glass was removed from a patient's back; it had been there for a year. It was surrounded by a minimal amount of fibrous tissue, lined by a glistening synovial sac, containing a few drops of clear yellow fluid.

Photo removed due to copyright considerations.

Smith-Peterson

J. Bone Jt. Surg., 30-B:59 (1948)

Four pages removed due to copyright considerations.

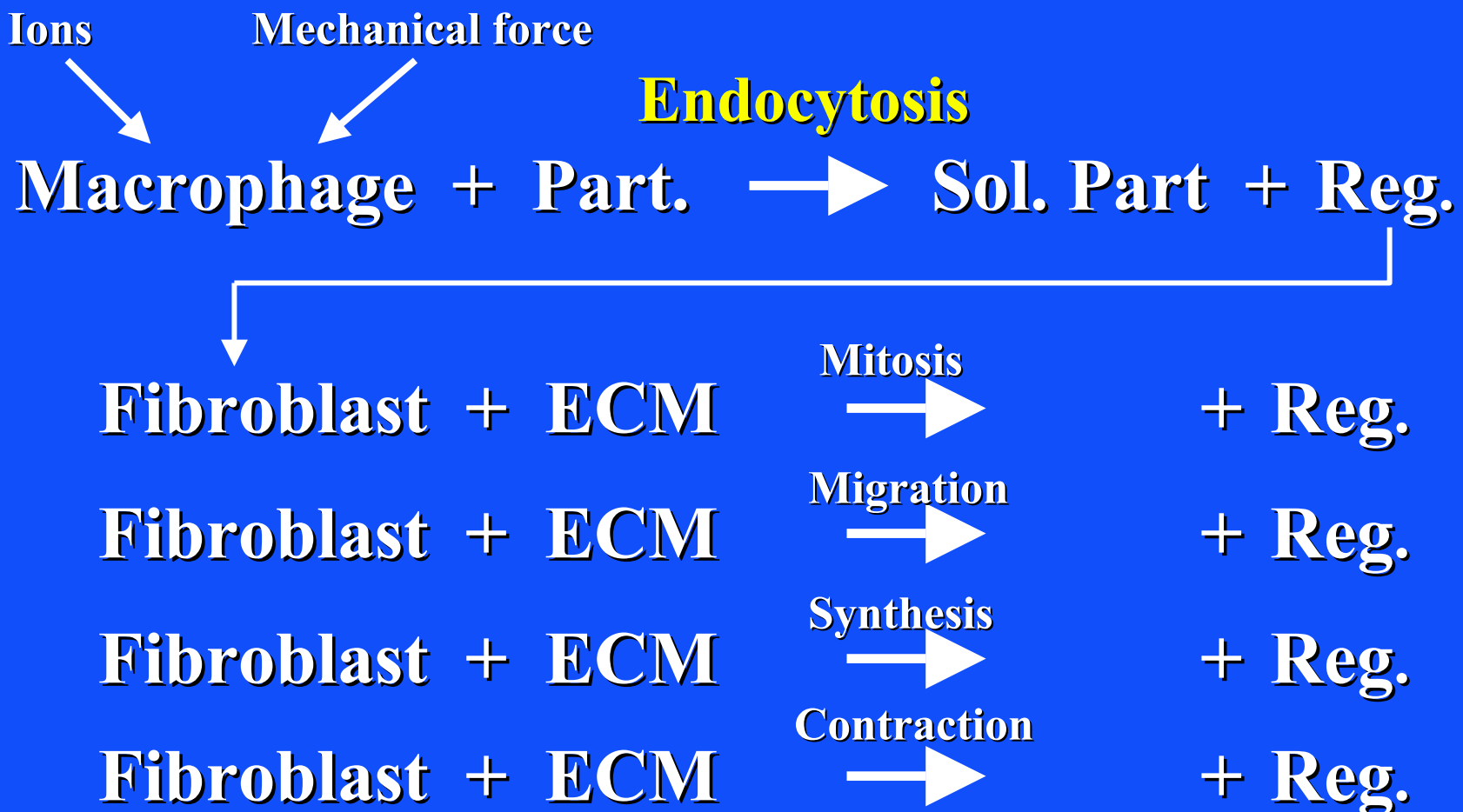
I. Silver

CHRONIC RESPONSE TO IMPLANTS

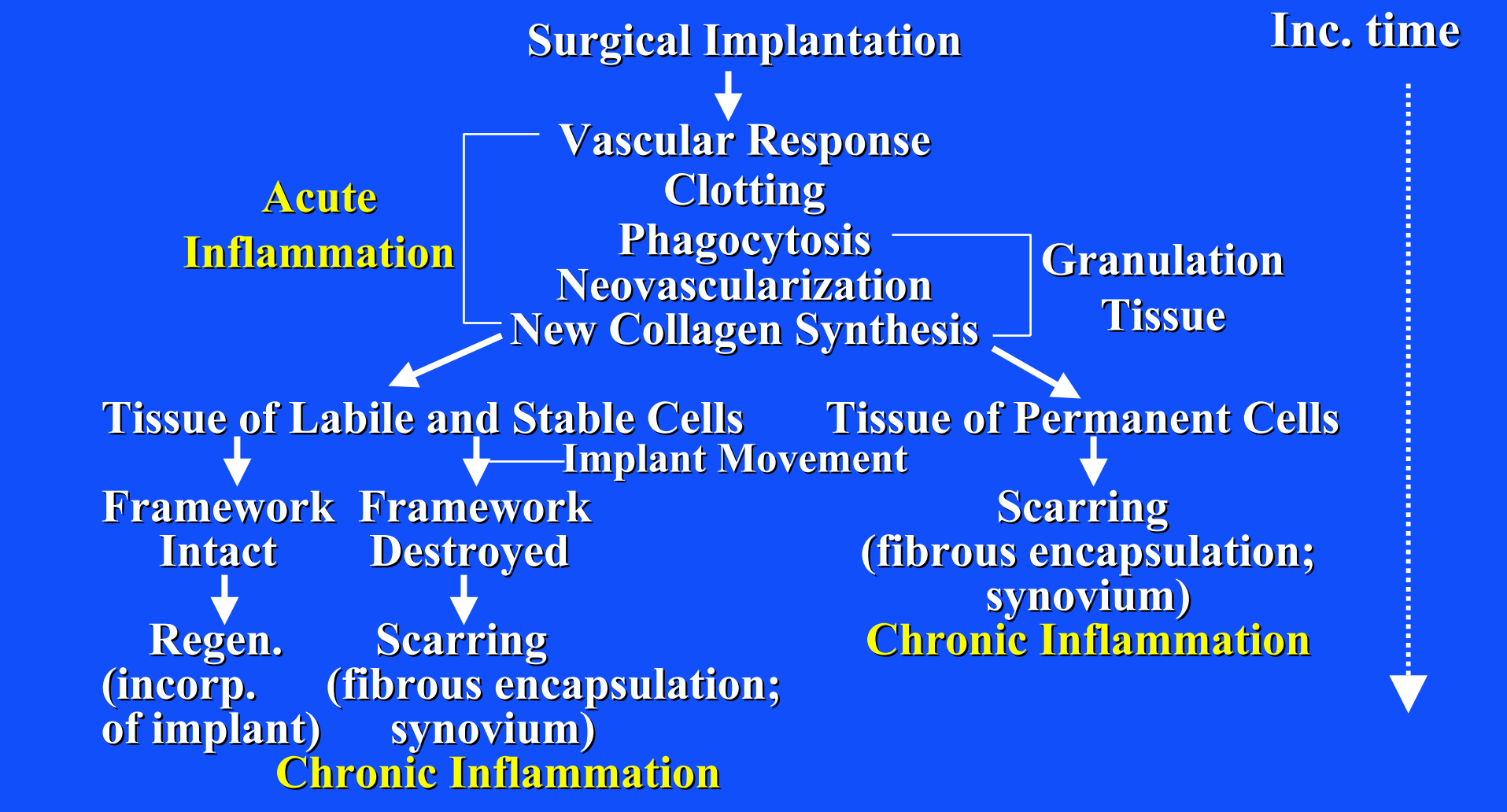
- Persistence of macrophages* at the implant surface
- Presence of fibroblasts*
- Proliferation and increased matrix synthesis of fibroblasts can result from mechanical perturbation by the implant or by agents released by the implant, leading to an increase in the thickness and density of the scar tissue.
- Fibroblast contraction can result in scar contracture.

* Constituents of synovium

MACROPHAGE AND FIBROBLAST INTERACTIONS IN SYNOVIUM



RESPONSE TO IMPLANTS: WOUND HEALING



IMPLANT MATERIALS/BIOMATERIALS TISSUE RESPONSE

Soft Tissue (that does not regenerate)

- Fibrous capsule (scar)

  Synovium: fibrous tissue interspersed with macrophages

  Wound healing response of repair (scar formation) coupled with macrophage accretion at the "dead space" - chronic inflammation

Bone

- Tissue integration and tissue bonding

TISSUE INTEGRATION
TISSUE BONDING

- **Tissue Integration (Osseointegration)**

  Apposition of tissue (bone) to the implant (contact of bone with the surface but not necessarily bonding); no macrophage layer?

  Regeneration of tissue up to the surface of the implant

- **Tissue Bonding (Bone Bonding)**

  Chemical bonding of tissue (*viz.*, bone) to the surface

  Protein adsorption and cell adhesion

  Biomaterials: calcium phosphates and titanium (?)

Dental Implant Designs and Materials

Carbon

Titanium

Alumina

Images removed due to copyright considerations.

Alumina

Carbon

Alumina

Blade Implant

Photos removed due to copyright considerations.

“Commercially pure” Titanium

Two-Stage Design;
to shield the artificial root from loading during the initial stage of healing

Images removed due to copyright considerations.

Osseointegration

Images removed due to copyright considerations.

T. Albrektsson, *et al*., Ann. Biomed. Engr., 11:1 (1983)
T. Albrektsson, CRC Crit. Rev. Biocompat., 1:53 (1984)

Osseointegration: Control of Surgical Trauma

Image removed due to copyright considerations.

T. Albrektsson, CRC Crit. Rev. Biocompat., 1:53 (1984)

Implants with Porous Coatings in Bone

Metal stem

Bone

Image removed due to copyright considerations.

Image removed due to copyright considerations.

Beaded porous coating

Image removed due to copyright considerations.

Bone

Hydroxyapatite-Coated Implants

Images removed due to copyright considerations.

Plasma-sprayed HA coating, 40 μm thick

3 hr

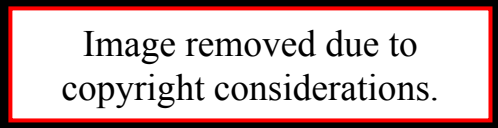
Image removed due to copyright considerations.

Image removed due to copyright considerations.

Cylindrical implant in canine prox. femur

6 da

Plasma-Sprayed Hydroxyapatite Coating



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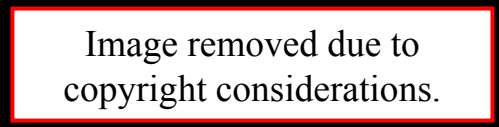

Bone regeneration in the gap between the implant surface and surrounding bone.

Plasma-Sprayed Hydroxyapatite Coating
14 days

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