Is the “ideal” biomaterial always one which is chemically inert? Why?

ANSWER: No, it is considered best if a biomaterial produces an appropriate response from the host.

Would the “ideal” hip joint implant be as strong as possible? Why?

ANSWER: No, it may be desirable that the implant is no stronger than the surrounding tissues.

Are there tests for and an agreed definition of biocompatibility? (Give a definition of biocompatibility.)

ANSWER: No, there are no agreed definitions and tests for biocompatibility. Biocompatibility — the ability of a biomaterial to respond properly in a specific biological/medical application (or something similar).

Give three main types of biomaterials and the main uses of each.

ANSWER: Metals: orthopaedics, electronics, etc.
Polymers: drug delivery, disposables, cosmetic prosthetics, etc.
Ceramics: bone replacements, bonding, drug carrier, etc.
Others (carbon, glass): heart valve prosthesis, coatings, etc.

What’s a protein/polypeptide?

ANSWER: polymers of amino acids. Typically, hundreds of the (nominally) twenty different amino acid monomers make up a polypeptide chain, and the sequence of monomers determines its shape and biological function (or something similar).

A polymer manufacturer has produced a new material which he believes is suitable for the manufacture of an artificial blood vessel. If necessary, he is willing to modify the polymer to suit your particular requirements. Construct a flow chart indicating the protocol you would follow to test the suitability of the new material for clinical use and to provide information to the manufacturer if the initial material proves unsuitable.

ANSWER: the following issues should be addressed: in vitro and in vivo studies including mechanical testing, cytotoxicity, hemolysis, etc.

Give at least five potential "undesirable" biomaterial reactions.

> ANSWER: Irritation, Inflammation, Necrosis, Pyrogenicity, Sensitization, Mutagenicity, Carcinogenicity or tumorigenesis, etc.

Why is biomaterials testing important? What are some of the standard tests?

> ANSWER: materials may interact with tissue and pose various effects to tissue. Tests for biomaterials include both in vitro and in vivo tests. Some of the standard tests include ASTM, ANSI, AAMI, ISO, etc.

What are the effects of host on biomaterials?

> ANSWER: Physical – mechanical effects: Abrasive wear, Fatigue, Stress-corrosion cracking, Corrosion, Degeneration and dissolution
> Biological effects: Absorption of substances from tissues, Enzymatic degradation, Calcification

Does the shape of an implant matter and if so why?

> ANSWER: The shape of an implant is important. Corners can give rise to high mechanical stresses and hence tissue responses.

Are there test for and an agreed definition of biocompatibility?

> ANSWER: No, there are no agreed definitions and tests for biocompatibility.

What are the features (at least five) of implant-associated infections? What strategies (at least three) can be used to decrease or prevent implant-associated infections?

ANSWER: Features of implant-associated infections may include:

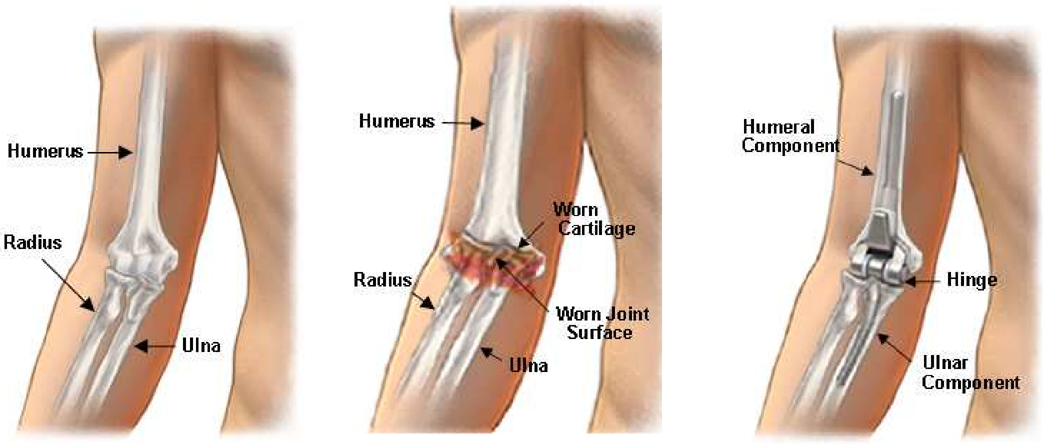
- Biomaterial or damaged tissue
- Adhesive colonization
- Resistance to host defense and antibiotics
- Specific materials, organisms, host location
- Transformation of nonpathogens to virulent form by biomaterial
- Infection persistence
- Polymicrobiality
- Tissue integration at biomaterial surface
- Tissue cell damage or necrosis

The following strategies can be applied to decrease or prevent impant-associated infections:

- Antibiotics, systemic or in situ
- Precolonization by healthy tissues
- Peptides and sugars on surface to encourage tissue adhesion and discourage pathogen adhesion
- Coating surface to direct biological activity
- Genetic modification of local tissue adhesion
- Better understanding of surface phenomenon and structure

Question 2-Research

The elbow is a hinge joint consisting of three bones. The upper part of the hinge is at the end of the upper arm bone (humerus), and the lower part of the hinge is at the top of the two forearm bones (radius and ulna) which are side by side. When the elbow is bent, the ends of the two forearm bones rub against the end of the humerus.



Bones of Elbow Joint

In a healthy elbow joint, the surfaces of these bones are very smooth and covered with a tough protective tissue called cartilage. Arthritis causes damage to the bone surfaces and cartilage where the three bones rub together. These damaged surfaces eventually become painful.

Elbow Joint Surfaces

There are many ways to treat the pain caused by arthritis. One way is total elbow replacement surgery. The decision to have total elbow replacement surgery should be made very carefully after consulting your doctor and learning as much as you can about the elbow joint, arthritis, and the surgery.

Getting to the Joint

The patient is first taken into the operating room and given anesthesia. After the anesthesia has taken effect, the skin around the elbow is thoroughly scrubbed and sterilized with an antiseptic liquid. A tourniquet is then applied to the upper portion of the arm to help slow the flow of blood.

An incision about six inches long is then made over the elbow joint. The incision is gradually made deeper through muscle and other tissue until the bones of the elbow joint are exposed.

Preparing the Bones

One of the forearm bones, the ulna, has a projection at the end, which extends up and behind the end of the humerus. A special power saw is used to remove part of this projection. This allows the two forearm bones to be rotated out of the way so parts of the humerus can be removed with the saw. Precision guides are used to help make sure that the cuts are made so the bones will align properly after the implant is inserted. The middle portion at the end of the humerus is removed first. The arm bones have relatively soft, porous bone tissue in the center. This part of the bone is called the "canal." Special instruments are used to clear some of this soft bone from the canal of the humerus. These instruments also help shape the canal to fit the shape of the implant. Then, similar instruments are used to clear some of the soft bone and shape the canal of the ulna.

Attaching the Implants

The elbow implant consists of two metal stems that are connected by a metal locking pin. This pin passes through the ends of both stems, which are lined with a strong plastic material, serving as a bearing that allows the elbow to bend. The stems are inserted into each of the two prepared canals. A special kind of cement for bones is first injected into the canals to help hold the stems in place. When the cement is hard, the two implant parts are brought together and the pin is inserted to connect them.

Closing the Wound

If necessary, the surgeon may adjust the ligaments that surround the elbow to achieve the best possible elbow function. When all of the implants are in place and the ligaments are properly adjusted, the surgeon sews the layers of tissue back into their proper position. A plastic tube may be inserted into the wound to allow liquids to drain from the site during the first few hours after surgery. The edges of the skin are then sewn together, and the elbow is wrapped in a sterile bandage. Finally, the patient is taken to the recovery room.

1-Explain:

- how the elbow joint works
- what happens during surgery to replace the elbow joint
- what you can expect after elbow joint replacement

2- Draw an implant action/facilitator plan for this implant from idea to clinical trial