The true purpose of education is to make mind not career. The quote reflects towards the incorporation of implant which is biocompatible and be accustomed in-vivo to regularize the normal physiological function. Medical implants are devices or tissues that are placed inside or on the surface of the body. Many implants are prosthetics, intended to replace missing body parts. Other implants deliver medication, monitor body functions, or provide support to organs and tissues. Examples include the artificial heart, artificial heart valve, implantable cardioverter-defibrillator, artificial cardiac pacemaker, and coronary stent. An implant is a medical device manufactured to replace a missing biological structure, support a damaged biological structure, or enhance an existing biological structure. Medical implants are man-made devices, in contrast to a transplant, which is a transplanted biomedical tissue. The surface of implants that contact the body might be made of a biomedical material such as titanium, silicone, or apatite depending on what is the most functional. In some cases implants contain electronics, e.g. artificial pacemaker and cochlear implants. Some implants are bioactive, such as subcutaneous drug delivery devices in the form of implantable pills or drug-eluting stents.
INTRODUCTION:
Arthritis is a common reason why people seek medical advice, and many people are taking medications prescribed by their healthcare providers for arthritis. Arthritis is a group of over 100 conditions that cause inflammation, swelling, and pain in the joints and connective tissue such as tendons, ligaments, and muscles. Arthritis is the most common cause of disability in the United States and affects millions of people of all ages. The symptoms of arthritis can vary from person to person and range from mild to severe. Arthritis can be caused by a variety of factors, including age, gender, family history, and environmental factors.

Symptoms:
Arthritis symptoms can include pain, swelling, stiffness, and limited mobility in the affected joints. The pain can be chronic or episodic and may be worse with activity or after periods of inactivity. Other symptoms may include joint tenderness, muscle weakness, and fatigue. Arthritis can affect any joint in the body, including the fingers, wrists, elbows, knees, hips, and ankles.

Causes:
Arthritis can be caused by a variety of factors, including age, gender, family history, and environmental factors. The most common types of arthritis include osteoarthritis (wear and tear), rheumatoid arthritis (an autoimmune disorder), and gout (a type of crystal arthritis). Other types of arthritis include reactive arthritis (inflammation following an infection), and psoriatic arthritis (a type of arthritis associated with psoriasis).

Treatment:
Treatment for arthritis depends on the type and severity of the condition. The goal of treatment is to relieve pain, reduce swelling, and improve mobility. Treatment options may include medication, physical therapy, and lifestyle changes. Medications may include non-steroidal anti-inflammatory drugs (NSAIDs), disease-modifying antirheumatic drugs (DMARDs), and biological therapies. Physical therapy can help improve joint mobility and reduce pain. Lifestyle changes may include losing weight, exercises to maintain joint flexibility, and modifying activities to reduce joint stress.

Conclusion:
Arthritis is a common chronic condition that affects millions of people worldwide. It is important to consult a healthcare provider for an accurate diagnosis and to develop a treatment plan that is tailored to the individual's needs. Early intervention and proper management can help to prevent further joint damage and improve quality of life.
Extra-articular features of joint disease

<table>
<thead>
<tr>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutaneous nodules</td>
</tr>
<tr>
<td>Cutaneous vasculitis lesions</td>
</tr>
<tr>
<td>Lymphadenopathy</td>
</tr>
<tr>
<td>Oedema</td>
</tr>
<tr>
<td>Ocular inflammation</td>
</tr>
<tr>
<td>Urethritis</td>
</tr>
<tr>
<td>Tenosynovitis (tendon sheath effusions)</td>
</tr>
<tr>
<td>Bursitis (swollen bursa)</td>
</tr>
<tr>
<td>Diarrhea</td>
</tr>
<tr>
<td>Orogenital ulceration</td>
</tr>
</tbody>
</table>

- Muscle weakness
- Loss of flexibility
- Decreased aerobic fitness

These changes, in addition to the primary symptoms, can have a huge impact on quality of life.

**Disability:** Arthritis is the most common cause of disability in the United States. More than 20 million individuals with arthritis have severe limitations in function on a daily basis. Absenteeism and frequent visits to the physician are common in individuals who have arthritis. Arthritis can make it difficult for individuals to be physically active and some become home bound. It is estimated that the total cost of arthritis cases is close to $100 billion of which almost 50% is from lost earnings. Each year, arthritis results in nearly 1 million hospitalizations and close to 45 million outpatient visits to health care centers. Decreased mobility, in combination with the above symptoms, can make it difficult for an individual to remain physically active, contributing to an increased risk of obesity, high cholesterol or vulnerability to heart disease. People with arthritis are also at increased risk of depression, which may be a response to numerous factors, including fear of worsening symptoms.[2]
Comparison of types:

<table>
<thead>
<tr>
<th>Arthritis types</th>
<th>Osteoarthritis</th>
<th>Rheumatoid arthritis</th>
<th>Gouty arthritis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Speed of onset</strong></td>
<td>Months</td>
<td>Weeks-months</td>
<td>Hours for an attack</td>
</tr>
<tr>
<td><strong>Main locations</strong></td>
<td>Weight-bearing joints (such as knees, hips, vertebral column) and hands</td>
<td>Hands (proximal interphalangeal and metacarpophalangeal joint) wrists, ankles, knees and hips</td>
<td>Great toe, ankles, knees and elbows</td>
</tr>
<tr>
<td><strong>Inflammation</strong></td>
<td>May occur, though often mild compared to inflammation in rheumatoid arthritis</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Radiologic changes</strong></td>
<td>• Narrowed joint space</td>
<td>• Narrowed joint space</td>
<td>• “Punched out” bone erosions</td>
</tr>
<tr>
<td></td>
<td>• Osteophytes</td>
<td>• Bone erosions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Local osteosclerosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Subchondral cysts</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Laboratory findings</strong></td>
<td>None</td>
<td>Anemia, elevated ESR and C-reactive protein (CRP), rheumatoid factor, anti-citrullinated protein antibody</td>
<td>Crystal in joints</td>
</tr>
<tr>
<td><strong>Other features</strong></td>
<td>• No systemic signs</td>
<td>• Extra-articular features are common</td>
<td>• Tophi</td>
</tr>
<tr>
<td></td>
<td>• Bouchard's and Heberden's nodes</td>
<td>• Ulnar deviation, swan neck- and Boutonniere deformity of the hand</td>
<td>• Nephrolithiasis</td>
</tr>
</tbody>
</table>

*Table-1: Various forms of arthritis*

Knee pain is pain in or around the knee.
The knee joint consists of an articulation between four bones: the femur, tibia, fibula and patella. There are four compartments to the knee. These are the medial and lateral tibiofemoral compartments, the patellofemoral compartment and the superior tibiofibular joint. The components of each of these compartments can experience repetitive strain, injury or disease. Running long distance can cause pain to the knee joint, as it is a high-impact exercise.[3]

**Causes**

### Injuries

Some common injuries include:

- **Sprain** (Ligament sprain)
  - Medial collateral ligament
  - Lateral collateral ligament
  - Anterior cruciate ligament
  - Posterior cruciate ligament

- **Tear of meniscus**
  - Medial meniscus
  - Lateral meniscus

- **Strain** (Muscle strain)
  - Quadriceps muscles
  - Hamstring muscles
  - Popliteal muscle
  - Patellar tendon
  - Hamstring tendon
  - Popliteal tendon

- **Hemarthrosis** – Hemarthrosis tends to develop over a relatively short period after injury, from several minutes to a few hours.

### Fractures

- Femoral fracture
- Tibial fracture
- Patella fracture

### Inflammations

- Bursitis of the knee
  - Infrapatellar bursitis - Clergyman's knee
  - Semimembranosus bursitis
  - Tendinitis
    - Patellar tendinitis *(Jumper's knee)*
    - Hamstring tendinitis
    - Popliteal tendinitis

### Synovitis of the knee

### Deformities

Common deformities of the knee include:

- Bipartite patella (two-part kneecap)
- Genu varum (bow legs)
- Genu valgum (knock-knees)
- Genu recurvatum (Knee hyperextension)
- Knee flexion deformity

### Syndromes

- Patellofemoral pain syndrome
- Plica syndrome
- Iliotibial band syndrome
- Hoffa's syndrome
- Joint hypermobility syndrome

### Dislocations

- Patella dislocation
- Knee joint dislocation *(Tibiofemoral joint dislocation)*

### Cold temperature:

Knee pain is more common among people working in the cold than in those in normal temperature. Cold-induced knee pain may also be due to tenosynovitis of the tendons around the knee, in which cold exposure has a specific role, either as a causative or a contributing factor. Frank arthritis has been reported in children due to frostbite from extreme cold causing direct chondrocyte injury. There is also a hereditary disease, familial cold autoinflammatory syndrome (FCAS), which often features knee pain, in addition to hives, fever and pain in other joints, following general exposure to cold.
Knee pain due to less physical movement: A lower level of physical activity and a work environment where one is required to sit in a chair during the work day is one reason for developing knee joint pain, as the lower degree of physical movement tends to weaken the knee muscles. Blood vessels also can be affected, leading to development of painful conditions. Working on building strength through a full range of motion is crucial for rebuilding strength and getting rid of knee pain.

As age progresses the movement of the knee joint involves higher friction with adjacent tissue and cartilages.[4]

Other causes
- Ligamentous laxity
- Fat pad impingement
- Knee effusion
- Deep vein thrombosis
- Peripheral vascular disease
- Exostosis

Joint stiffness: may be either the symptom of pain on moving a joint, the symptom of loss of range of motion or the physical sign of reduced range of motion.

Figure-3: Joint Stiffness

- Pain on movement is commonly caused by osteoarthritis, often in quite minor degrees, and other forms of arthritis. It may also be caused by injury or overuse and rarely by more complex causes of pain such as infection or neoplasm. The range of motion may be normal or limited by pain. "Morning stiffness" pain which eases up after the joint has been used, is characteristic of rheumatoid arthritis.
- Loss of motion (symptom): the patient notices that the joint (or many joints) do not move as far as they used to or need to. Loss of motion is a feature of more advanced stages of arthritis including osteoarthritis, rheumatoid arthritis and ankylosing spondylitis.
- Loss of range of motion (sign): the examining medical professional notes that the range of motion of the joint is less than normal. Routine examination by an orthopaedic surgeon or rheumatologist will often pay particular attention to this. The range of motion may be measured and compared to the other side and to normal ranges. This sign is associated with the same causes as the symptom. In extreme cases when the joint does not move at all it is said to be ankylosed.

Pain in the hip: is the experience of pain in the muscles or joints in the hip/ pelvic region, a condition commonly arising from any of a number of factors. Sometimes it is closely associated with lower back pain.

Causes: Causes of pain around the hip joint may be intra-articular, extra-articular, or referred pain from neighboring structures, such as sacroiliac joint, spine, symphysis pubis, or the inguinal canal.

Common etiologies include:
- Trochanteric bursitis, caused by inflammation of the trochanteric bursa of the outer hip, often affecting both hips
- Arthritis of the hip, degeneration of the hip joint from osteonecrosis, trauma, sepsis, rheumatoid arthritis, or anatomic anomalies
- Meralgia paresthetica, a chronic neurological disorder of the lateral femoral cutaneous nerve, most common among those who are pregnant or have diabetes
- Hip avascular necrosis, cell death of bone tissue in the hip joint brought on by vascular occlusion or coagulation which is the result of old age, alcoholism, trauma, decompression sickness, or several other possible causes; the treatment is often total hip replacement
- Occult hip fracture, a fine crack somewhere in the hip socket, common in elderly women and those with osteoporosis, usually only in one hip
Snapping hip, a condition caused by iliotibial band snap, iliopsoas tendon snap, and hip labral tear, usually only in one hip; may be accompanied by an audible “snap” when the hip joint is moved

- Paget’s disease, enlarged or deformed bones of the hip, a genetic disorder; pain is usually in both hips simultaneously
- Malignancy, as cancer in the pelvis or proximal femur may cause pain; usually only one hip is affected
- Primary septic arthritis caused by an infection within the synovial fluid of the hip, a condition rare in adults except for those who are already immunocompromised as well as those who have artificial hips; only one side of the pelvis is affected, onset of pain is rapid
- Transient or acute synovitis or "irritable hip", a condition most common in children, more often in boys than girls, and clearing up on its own within 7–10 days; pain is only on one side
- Sciatica, a condition most often brought on by damage to the L4 or L5 nerve roots but sometimes caused by inflammation or tension in the piriformis muscle of the pelvis (which rests on the sciatic nerve), in which case the condition is called piriformis syndrome; pain usually only occurs in one side but may occur in the other side at other times or (rarely) both sides simultaneously
- Sacroiliac joint dysfunction, an uncommon neurological condition of the mostly-immobile sacroiliac joint of the hip brought on by previous trauma to the joint such as an automobile accident; pain will usually be in only one side
- Radiculopathy, a nerve disorder brought on by pressure or irritation of a nerve at its root (i.e., near the spine) often resulting from degeneration of a spinal disc, joint degeneration, or osteoarthritis, among other causes

Pain in the groin, called anterior hip pain, is most often the result of osteoarthritis, osteonecrosis, occult fracture, acute synovitis, and septic arthritis; pain on the sides of the hip, called lateral hip pain, is usually caused by bursitis; pain in the buttock, called posterior or gluteal hip pain, which is the least common type of hip pain, is most often caused by sacroiliac joint dysfunction as well as sciatica (whether from a hemorrhaged spinal disk or a tense piriformis muscle). Herpes zoster (shingles) may also cause posterior hip pain.

Clinical examination: Clinical tests are adapted to identify the source of pain as intra-articular or extra-articular. The flexion-abduction-external rotation (FABER), internal range of motion with overpressure (IROP), and scour tests show sensitivity values in identifying individuals with intra-articular pathology ranging from 0.62 to 0.91.

Medical imaging: Projectional radiography ("X-ray") is the first imaging technique of choice in hip pain, not only in older people with suspected osteoarthritis but also in young people without any such suspicion. In this case plain radiography allows categorization as normal hip or dysplastic hip, or with impingement signs, pincer, cam, or a combination of both. Need for clinical correlation: Imaging of the hip needs to be complementary to the clinical history and physical examination because it is well known that imaging findings do not always correlate with the presence of pain and vice versa.\(^5\)

X-Ray: Projectional radiography ("X-ray") is currently useful not only in older people in whom osteoarthritis of the hip is suspected but also in younger people without osteoarthritis, who are being evaluated for femoroacetabular impingement (FAI) or hip dysplasia. Plain radiography allows us to categorize the hip as normal or dysplastic or with impingement signs (pincer, cam, or a combination of both). Besides these, pathologic processes like osteoarthritis, inflammatory diseases, infection, or tumors can also be identified.

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**Figure-4: Radiography in normal hip**
X-ray in paediatrics: X-ray of infants should be obtained with the pelvis in neutral position with the lower limbs held in neutral rotation and slight flexion.

Hip dysplasia: Despite the widespread of ultrasound, pelvis X-ray is still frequently used to diagnose and/or monitor hip dysplasia or for assessing other congenital conditions or bone tumors.

The most useful lines and angles that can be drawn in the pediatric pelvis assessing DDH are as follows:
Legg-Calvé-Perthes disease (LCPD): Most cases of Legg-Calvé-Perthes disease (LCPD) develop between the ages of 4 and 10 years (Figure 3). Classification of its severity can be assessed by radiographs. Herring or lateral pillar classifications and the patient’s age strongly correlate with the outcome.\[6\]

**Figure-9**: Normal hip.

**Figure-10**: Hip dysplasia.

**Figure-11**: AP view of a patient with left hip effusion secondary to trauma showing widening of the medial joint space.

**Figure-12**: Herring lateral pillar classification
In Group A, which has a better prognosis, there are no loss of height in the lateral third of the femoral head and little density changes; in Group B, there is lucency and lateral height loss of less than 50%; and in Group C, the most severe form, there is more than 50% loss of lateral height. Group B/C is considered when the loss of lateral pillar height is at 50%. People who are over the age of 8 years at the time of onset and have a hip in the lateral pillar B group or B/C border group have a better outcome with surgical treatment than they do with conservative treatment. Group B hips in children who are less than 8 years at the time of onset have a very favorable outcome unrelated to the treatment, whereas Group C hips in children of all ages usually have poor outcome unrelated to the treatment.

Slipped capital femoral epiphyses (SCFE): Slipped capital femoral epiphyses (SCFE) usually affect 11- to 14-year-old adolescents (Figure 4). Radiographs may show widening and irregularity of the physis and posterior inferior displacement of the capital femoral epiphysis. On the AP view Klein’s line, tangent to the lateral aspect of the femoral neck, does not intersect the femoral head indicating that it is displaced. SCFE may compromise the blood supply to the femoral head and cause avascular necrosis, mainly when there is instability between the fragments.\(^7\)
X-ray in adults

*Figure-15: X-ray of the hips of a 40-year-old female, with dysplasia of her right hip.*

**Sacroiliac joint dysfunction**

Measurements of hip dysplasia in adults are quite different from those in children.

**Sacroiliac joint dysfunction** generally refers to pain in the sacroiliac joint region that is caused by abnormal motion in the sacroiliac joint, either too much motion or too little motion.[8]

**Signs and symptoms:** Common symptoms include lower back pain, buttocks pain, sciatic leg pain, groin pain, hip pain (for explanation of leg, groin, and hip pain, see referred pain), urinary frequency, and "transient numbness, prickling, or tingling." Pain can range from dull aching to sharp and stabbing and increases with physical activity. Symptoms also worsen with prolonged or sustained positions (i.e., sitting, standing, lying). Bending forward, stair climbing, hill climbing, and rising from a seated position can also provoke pain. Pain can increase during menstruation in women. People with severe and disabling sacroiliac joint dysfunction can develop insomnia and depression. Sacral torsion that is untreated over a long period of time can cause severe Achilles tendinosis.

**Causes**

**Hypermobility:** Sacroiliac joint dysfunction is an outcome of either extra-articular dysfunction or from intraarticular dysfunction. SI joint dysfunction is sometimes referred to as "sacroiliac joint instability" or "sacroiliac joint insufficiency" due to the support the once strong and taut ligaments can no longer sustain. When the joint is hypermobile or loose, it is classified as an extra-articular dysfunction because abnormal joint movement and alignment is a consequence of weakened, injured, or sprained ligaments, while the joint itself is structurally normal and healthy. The sacroiliac joint itself often will not show degenerative changes, such as arthritis, until many years of the dysfunction being allowed to continue. Injury to the ligaments that hold the sacroiliac joints in proper support is thought to be caused by a torsion or high impact injury (such as an automobile accident) or a hard fall, resulting in the hypermobility. As many as 58% of people diagnosed with sacroiliac joint pain had some inciting traumatic injury based on clinical examination findings. The joint that was once stabilized by strong ligaments, now overly stretched, sprained, or torn, will move beyond its normal range. This is thought to result in the ilium and sacral surfaces "locking" in an incongruent or asymmetrical fashion (one innominate bone is tilted anteriorly; the other innominate bone is tilted posteriorly) causing pain that can be debilitating. Hormone imbalances, particularly those associated with pregnancy and the hormone relaxin, can also cause a ligamentous laxity resulting in the weakening of the sacroiliac...
structure. During pregnancy, relaxin serves as nature’s way of allowing the female pelvis to achieve distention of the birthing canal. Pelvic joint pain in post pregnancy women is thought to be derived from the inability of the stretched out ligaments to return to normal tautness. Women who have delivered large babies or who have had extended labors also are prone to developing chronic sacroiliac joint pain and instability. In some people, the sacroiliac joints reverse the normal concave-convex ‘locking’ relationship, which can lead to rotational misalignment. The variation in joint configuration results in some sacroiliac joints being inherently weaker or more prone to misalignment.

Certain biomechanical or muscle length imbalances may ultimately predispose a person to sacroiliac dysfunction and pain. Likely, this is a result of altered gait patterns and repetitive stress to the SI joint and related structures. These conditions exist in persons with leg-length inequality, scoliosis, a history of polio, poor-quality footwear, and hip osteoarthritis. There is also a notable incidence of lumbar spinal fusion patients that present with sacroiliac pain and hypermobility, potentially due to the adjacent lumbar joints being fixed and unable to move. Clinical studies have found up to 75% of post-lumbar fusion patients develop SI joint degeneration within five years of surgery.

Hypomobility: Pathological hypomobility (too little movement) of the sacroiliac joint is an intra-articular disorder in which the joint locks due to wearing down with age or degenerative joint disease. Hypomobility of this kind can also occur with an inflammatory disease such as ankylosing spondylitis, rheumatoid arthritis, or an infection.

Pathophysiology: The sacroiliac joint is a true diarthrodial joint that joins the sacrum to the pelvis. The sacrum connects on the right and left sides to the ilia (pelvic bones) to form the sacroiliac joints. The pelvic girdle is made up of two innominate bones (the iliac bones) and the sacrum. The innominate bones join in the front of the pelvis to form the pubic symphysis, and at back of the sacrum to form the sacroiliac (SI) joints. Each innominate bone (ilium) joins the femur (thigh bone) to form the hip joint; thus the sacroiliac joint moves with walking and movement of the torso. In this joint, hyaline cartilage on the sacral side moves against fibrocartilage on the iliac side. The sacroiliac joint contains numerous ridges and depressions that function in stability. Studies have documented that motion does occur at the joint; therefore, slightly subluxed and even locked positions can occur. Muscles and ligaments surround and attach to the SI joint in the front and back, primarily on the ilial or sacral surfaces. These can all be a source of pain and inflammation if the SI joint is dysfunctional. The sacroiliac joint is highly dependent on its strong ligamentous structure for support and stability. The most commonly disrupted and/or torn ligaments are the iliolumbar ligament and the posterior sacroiliac ligament. The ligamentous structures offer resistance to shear and loading. The deep anterior, posterior, and intersosseus ligaments resist the load of the sacrum relative to the ilium. More superficial ligaments (e.g., the sacrotuberous ligament) react to dynamic motions (such as straight-leg raising during physical motion). The long dorsal sacroiliac ligament can become stretched in periods of increased lumbar lordosis (e.g., during pregnancy). [9]

Affected muscle groups: Many large and small muscles have relationships with the ligaments of the sacroiliac joint including the piriformis (see “piriformis syndrome”, a condition often related with sacroiliac joint dysfunction), rectus femoris, gluteus maximus and minimus, erector spinae, latissimus dorsi, thoracolumbar fascia, and iliacus. Any of these muscles can be involved or spasm with a painful and dysfunctional sacroiliac joint. The SI joint is a pain-sensitive structure richly innervated by a combination of unmyelinated free nerve endings and the posterior primary rami of spinal segments L2-S3. The wide possibility of innervation may explain why pain originating from the joint can manifest in so many various ways, with different and unique referral patterns (see "referred pain") for individual patients. Patients with sacroiliac joint dysfunction can also develop tightness and dysfunction in the hamstring, quadriceps, iliobibial tract (see “iliotibial band syndrome”) and hip flexors, including the psoas muscle. Individuals with severe and long-standing sacroiliac joint dysfunction can develop muscle deconditioning and atrophy throughout the body due to limitation of activities and exercise that bring about pain in the low back.

Overview: An implant is a medical device manufactured to replace a missing biological structure, support a damaged biological structure, or enhance an existing biological structure. Implant is a tissue or organ inserted surgically into the human body to replace a defective one, whereas prosthesis is an artificial substitute for a missing part. Medical implants are man-made devices, in contrast to a transplant, which is a transplanted biomedical tissue. The surface of implants that contact the body might be made of a biomedical material such as titanium, silicone, orapatite depending on what is the most functional. Titanium (Ti) and its alloys (mainly Ti-6Al-4V) have become the metals of choice for dental implants.
However, prosthetic components of the implants are still made from gold alloys, stainless steel, and cobalt-chromium and nickel-chromium alloys. In some cases implants contain electronics, e.g. artificial pacemaker and cochlear implants. Some implants are bioactive, such as subcutaneous drug delivery devices in the form of implantable pills or drug-eluting stents. Implant is a device that is placed into a surgically or naturally formed cavity of the human body and is intended to remain there for a period of 30 days or more.\[10\]

Per-Ingvar Branemark [Per-Ingvar Brånemark (May 3, 1929 – December 20, 2014) was a Swedish physician and research professor, acknowledged as the "father of modern dental implantology".]

William Fouts House (December 1, 1923 in Kansas City, Missouri – December 7, 2012 in Aurora, Oregon) was an American otologist, physician and medical researcher who developed and invented the cochlear implant.

Themistocles Gluck (30 November 1853 in Iaşi, Moldavia – 25 April 1942 in Berlin) was a German physician and surgeon. He first invented endoprostheses from ivory in 1890 at Berlin when he performed the first documented total wrist Arthroplasty.

Rune Elmqvist (1906–1996) developed the first implantable pacemaker in 1958, working under the direction of Åke Senning, senior physician and cardiac surgeon at the Karolinska University Hospital in Solna, Sweden.

In order to protect public health, FDA may determine that devices placed in subjects for shorter periods are also implants. Saline implants have been around for many years and continue to be the preferred choice for a large number of women. Because saline implants can be inserted unfilled, the incision required for saline breast implants is often smaller than that used for silicone breast implants. Silicone breast implants are the most natural-feeling option. They consist of a silicone shell filled with silicone gel. Silicone implants look and feel more like natural breast tissue and are the preferred material for many patients. Silicone implants are approved by the FDA for patients 22 and older. If you have a good amount of tissue in your breast, or if you have breast implants placed in a submuscular position, the breast implants will not be as palpable, so it won't matter as much. In general, silicone breast implants feel most like youthful breast tissue, firm, but yielding. Implants are used to replace the tooth's root and look like a screw. The screw is placed in the jawbone, and then a custom crown (or tooth replica) has a connector on it, called abutment. This abutment then fits into the screw that is within the jawbone to secure the custom crown. There are three common types of dental implants that you can choose from Endosteal, subperiosteal, and zygomatic. Endosteal is the safest and most common, followed by subperiosteal, and then zygomatic being the last and most complex. It is rarely used. Most orthopaedic implants are made of titanium alloys and stainless steel, and a few of them may even be lined with plastic. The metallic structure provides the implant with the necessary strength, while the plastic lining serves as artificial cartilage. The average saline or silicone implants may last anywhere from 10 to 20 years. However, many are removed sooner due to complications or cosmetic concerns. Up to 20 percent of people have their implants removed or replaced within 8 to 10 years.\[11\]

During surgery to place the dental implant, your oral surgeon makes a cut to open your gum and expose the bone. Holes are drilled into the bone where the dental implant metal post will be placed. Since the post will serve as the tooth root, it's implanted deep into the bone. A straightforward dental implant, for a patient with good bones and who does not need a lot of soft tissue surgery, has a pain level between two and three in the first 24 to 48 hours, which means over-the-counter medication like Tylenol or Advil will take care of any discomfort they are feeling.\[9\]

**Type of implants:**

Endosteal. These dental implants are placed in the jawbone.

Subperiosteal. These dental implants are placed under the gum but on, or above, the jawbone.
Bone augmentation.
Sinus lift.
Ridge expansion.

Applications:

**Sensory & Neurological:** 1969 – The first cochlear implant is implanted restoring a sense of sound and demonstrating the possibilities of neural implants. 1997 – Deep Brain Stimulation is approved in the USA as a treatment for Parkinson's disease aural. Implants are used for deep brain stimulation, vagus nerve stimulation, and mind-controlled prostheses. X-rays of a patient with Parkinson's disease show the electrodes of a deep brain stimulator implanted in the brain. This "brain pacemaker" emits electrical impulses to treat the disease’s motor symptoms. A brain (or neural) implant is a technological system that enables communication between the brain and electronic devices, thus permitting brain activity to be modified, recorded, and/or translated for the modification of devices such as a computer cursor or a robotic arm. The modification of brain activity, typically through electrical stimulation, has a number of medical applications, including the disruption of maladaptive brain activity that arises from neurological diseases such as epilepsy and Parkinson’s disease, or the creation of new sensory pathways to assist, for example, the blind or individuals who have lost their sense of touch and body position. Brain recordings can be used to monitor abnormal brain activity and trigger assistive measures (for instance, detection of the onset of an epileptic seizure can trigger therapeutic electrical stimulation to disrupt seizure progression and notify medical personnel). For the paralyzed, a brain implant can record neural activity in order to directly control external assistive devices such as robotic arms, computer interfaces, and wheelchairs. A brain implant for assisting paralyzed individuals is commonly referred to as a neural prosthetic.[12]

**Cardiovascular:** Cardiovascular implants find wide clinical applications, making a great contribution to the treatment of cardiovascular diseases. Although several commercial cardiovascular implants are approved by FDA and millions of patients benefit from these products, there are still not ideal device which can help patients recover completely by the way of a perfect physiological function of the substitutes or a perfect tissue regeneration. In order to overcome unexpected interaction between surface and tissues, surface modification has been introduced for cardiovascular devices to allow independent tailoring of surface and bulk properties. Developing strategies, such as the enrichment of the materials’ surfaces with specific peptides able to contain the inflammatory response while inducing a functional endothelialization, should indicate the promising way for the next generation for vascular repair. Nearly one-fourth of all deaths worldwide are attributable to cardiovascular diseases, including stroke and ischemic heart disease. Vascular and cardiovascular implants including vascular stents, vascular grafts,
polymeric heart valves intervention is necessary to treat cardio-vascular diseases. Cardiac implantable electronic devices, including pacemakers, implantable cardioverter defibrillator (ICD), biventricular pacemakers, and cardiac loop recorders, are designed to help control or monitor irregular heartbeats in people with certain heart rhythm disorders and heart failure.\textsuperscript{[13]}

What are the two most common types of pacemakers implanted?

The main types are: single-chamber pacemaker – this has 1 wire, which is connected to either the right atrium (upper heart chamber) or right ventricle (lower heart chamber) dual-chamber pacemaker – this has 2 wires, which are connected to the right atrium. While functioning like a normal pacemaker to treat slow heart rhythms, a CRT-P device also delivers small electrical impulses to the left and right ventricles to help them contract at the same time. This will help your heart pump more efficiently right ventricle.

**Micra:** The Newest Generation of Pacemaker. The Micra pacemaker is a significant breakthrough for patients in many ways, including a streamlined implantation method and an improved quality of life. Micra is about one inch long and one-quarter of an inch wide — 93 percent smaller than traditional pacemakers.

**Orthopedic:** An orthopedic implant is a device surgically placed into the body designed to restore function by replacing or reinforcing a damaged structure. For the treatment of back pain, orthopedic implants such as bone plates and bone screws are used in spinal fusion surgery and fixation of fractured bone segments, as well as implant components used for hip and joint replacement. The material used in orthopedic implants must be biocompatible to avoid rejection by the body. Other risks associated with orthopedic implants include implants coming loose or breaking in the bone causing painful inflammation and infection to surrounding tissue. Titanium is a common metal used for implantation in orthopedic surgery. While titanium is a metallic element, the majority of orthopedic “titanium implants” are, in fact, alloys. These alloys are typically proprietary blends - differing from manufacturer to manufacturer. Orthopedic implants are those materials that are used for hard tissue applications to replace bones and joints. Also included in this category are fixation plates that are implanted to stabilize fractured bones.\textsuperscript{[14]}

1. **Bone screw:** A bone screw is a metal implant inserted into the bone. Screws are used to immobilize fractured bone segments to aid in the healing process, and as an adjunct to spine fusion surgery to help hold implants in place. An example of a bone screw commonly used in spine fusion surgery is called a pedicle screw, which holds rods into the spine. The screws are placed at two (or sometimes three) consecutive spine segments (e.g. lumbar segment 4 and 5) and then a short rod is used to connect the screws. The design of the screws and rods helps prevent motion at the spinal segments that are being fused, thus aiding in the bone healing process of the fusion. After the bone graft grows and a fusion has taken place, the screws and rods are no longer needed for stability but are usually left in place.

2. **Bone plate:** A bone plate is a thin metal implant used to immobilize bone segments. The plate is affixed with screws to properly align the bone and aid in the healing process. In spine surgery, a bone plate may be used to help stabilize the fused area and prevent dislodgement of the bone graft. It is used most commonly in cervical fusion surgery (in the neck). Cortical bone is the dense outer surface of bone that forms a protective layer around the internal cavity. This type of bone also known as compact bone makes up nearly 80% of skeletal mass and is imperative to body structure and weight bearing because of its high resistance to bending and torsion. A bone plate is a thin metal implant used to immobilize bone segments. The plate is affixed with screws to properly align the bone and aid in the healing process. In spine surgery, a bone plate may be used to help stabilize the fused area and prevent dislodgement of the bone graft. It is used most commonly in cervical fusion surgery (in the neck).
Cortical bone: Cortical bone in the spine, arms and legs can be damaged by trauma or bone disease such as osteoporosis. To treat weakened cortical bone, cortical bone grafting can be employed using synthetic bone material and other surgical implants including metal plates, screws and wires to reinforce weakened areas of the bone.

Corpectomy: A corpectomy is a surgical procedure to remove a vertebral body, usually to decompress the spinal cord. In this surgery, the vertebral bodies and adjacent vertebral discs are removed in order to alleviate the pressure on the spinal cord, which is causing spinal stenosis and cervical myelopathy. A bone graft is then inserted into the space to allow for a fusion of the bone segments into one long bone. The procedure can also be used to treat some fractures, tumors, infections or spinal deformities. In Latin, "Corpus" means body and "ectomy" means remove.[15]

Spinal fusion: Spinal fusion is a surgery designed to decrease back pain by stopping the motion at a vertebral segment. The procedure involves placing a bone graft to an area of the spine to set up the natural process that causes the bone graft to grow between the two vertebral segments. Spinal fusion at one motion segment may be effective in relieving back pain; however, spinal fusion of more than two segments is rarely advised since it removes normal motion in the lower back and places too much stress across the remaining joints. Spinal fusion may be recommended for patients with pain and loss of function from degenerative disc disease or spondylolisthesis, or with deformity from scoliosis and other spinal problems.

When are orthopedic implants removed? Symptomatic hardware frequently needs removal. We found that pain and implant prominence (mechanical symptoms) are the most common indications. Infection is the next most common, followed by hardware failure. Other indications are implant failure, bone resorption due to excessive stress shielding and patient's will.[16]

1. Eponymous implants and their uses
   - Austin-Moore prosthesis for fracture of the neck of femur
   - Baksi’s prosthesis for elbow replacement
   - Charnley prosthesis for total hip replacement
   - Condylar blade plate for condylar fractures of femur
   - Ender’s nail for fixing intertrochanteric fracture
   - Grosse-Kempf nail for tibial or femoral shaft fracture
   - Hansson pin (or LIH for Lars Ingvar Hansson), a hook-pin used for fractures of the femoral neck
   - Harrington rod for fixation of the spine
   - Hart shill rectangle for fixation of the spine
   - Insall Burstein prosthesis: for total knee replacement
   - Richard N.W. Wohns interspinous implant and implantation instrument intended to be implanted between two adjacent dorsal spines
   - Kirschner wire for fixation of small bones
   - Kuntscher nail for fracture of the shaft of femur
   - Luque rod: for fixation of the spine
   - Moore’s pin for fracture of the neck of femur
   - Neer’s prosthesis for shoulder replacement
   - Rush nail for diaphyseal fracture of a long bone
   - Smith Peterson nail for fracture of the neck of femur
   - Smith Peterson nail with McLaughlin’s plate for intertrochanteric fracture
   - Seidel nail for fracture of the shaft of humerus
   - Souter’s prosthesis for elbow replacement
   - Steffee plate for fixation of the spine
   - Steinmann pin for skeletal traction
   - Swanson prosthesis for the replacement of joints of the fingers
   - Talwalkar nail for fracture of radius and ulna
   - Thompson prosthesis for fracture of the neck
Electrical implants:
What is an electrical implant? A spinal cord stimulator is an implanted device that sends low levels of electricity directly into the spinal cord to relieve pain. Spinal cord stimulators consist of thin wires (the electrodes) and a small, pacemaker-like battery pack (the generator). The electrodes are placed between the spinal cord and the vertebrae (the epidural space), and the generator is placed under the skin, usually near the buttocks or abdomen. Spinal cord stimulators allow patients to send the electrical impulses using a remote control when they feel pain. Both the remote control and its antenna are outside the body. Experts still don’t fully understand the mechanisms behind spinal cord stimulation, but they now know that it may target multiple muscle groups directly from the spine and even alter how the brain senses pain.[17]

Traditional spinal cord stimulators replace the sensation of pain with light tingling, called paresthesia. For patients who find these paresthesiae uncomfortable, newer devices offer “sub-perception” stimulation that cannot be felt. Many of the latest devices are placed by physicians with highly specialized training in interventional pain management under X-ray and/or ultrasound guidance.[18]

Contraceptive implants: The contraceptive implant (Nexplanon) is a small flexible plastic rod that’s placed under the skin in your upper arm by a doctor or nurse. It releases the hormone progestogen into your bloodstream to prevent pregnancy and lasts for 3 years. According to the Centers for Disease Control and Prevention (CDC), less than 1 out of every 100 people using the implant became pregnant. The Guttmacher Institute reports that over 1.4 million people in the United States use a birth control implant.[19]

Advantages:
- **Effectiveness.** It’s one of the most effective birth control methods available.
- **Longevity.** Once inserted, the implant lasts 3 years before needing to be replaced.
- **Convenience.** No pre-sex prep or reminders.
Cost effective. It can be a bit costly upfront, but there are no costs beyond that for 3 years.

Better periods. It can improve cramps, make periods lighter, or stop them entirely for some.

Reversible. You can remove it at any time and your fertility will return as soon as it’s removed.

No estrogen. It’s safe for people who can’t use birth control that contains estrogen.

Disadvantages:

- It doesn’t protect against sexually transmitted infections (STIs).
- Insertion requires a visit to a healthcare professional.
- The device must be removed after 3 years.
- Though rare, the implant can migrate from the insertion site, making it difficult for a clinician to find and remove.

Cosmetic implants: Cosmetic implant surgery can make some body parts look rounder, fuller and more defined. For example, buttock implants may make a person’s bottom rounder, while pectoral implants are usually performed on men who wish to have a chest that appears muscular. Cosmetic implants can be classified into several categories: facial implants, breast implants, pectoral and abdominal implants, testicular implants, upper and lower limb implants.\(^{[20]}\)

Complications: Loose implant. Probably the most common complication is an implant that has come loose.

- Infection. Another common complication of oral implants is infection.
- Bleeding.
- Micro-movement.
- Allergic reaction.
- Nerve damage.
- Protrusion into the sinus cavity.

Failure: Recurrent implantation failure refers to failure to achieve a clinical pregnancy after transfer of at least four good-quality embryos in a minimum of three fresh or frozen cycles in a woman under the age of 40 years. The failure to implant may be a consequence of embryo or uterine factors.

Conclusion: Implants can be used to replace body parts such as hips or knees, deliver medication such as for pain relief, monitor and regulate body functions such as heart rate, and provide support to organs and tissues. Some implants are inert and intended to provide structural support such as surgical meshes or stents. Implantable drug pumps are used to deliver insulin in the treatment of diabetics and to administer pain medications directly to the spine (intrathecal pumps). These are typically programmable “active” devices which require regular resupply of the medication through an access port. An Active Implantable Medical Device (AIMD) is an active medical device intended to be totally or partially introduced into the human body for diagnostic or therapeutic purposes and is to remain in place. In Australia, the device must be implanted in the body for at least 30 days. Out of the nearly 300,000 breast augmentation procedures performed in 2019, silicone implants accounted for 85%, while saline implants made up the other 15%. Existing breast tissue – The amount of breast tissue you currently have will also affect the size of the implant you select. Titanium (Ti) and its alloys (mainly Ti-6Al-4V) have become the metals of choice for dental implants. However, prosthetic components of the implants are still made from gold alloys, stainless steel, and cobalt-chromium and nickel-chromium alloys. Many implants are prosthetics, intended to replace missing body parts. Other
implants deliver medication, monitor body functions, or provide support to organs and tissues. Some implants are made from skin, bone or other body tissues. Others are made from metal, plastic, ceramic or other materials. More than 60 companies manufacture types of dental implants and/or the materials used to create them. As a result, dentists have many options for identifying the right treatment for specific patient needs. Coatings: There are several different coating types or surface treatments your implants can have. The most common metals and alloys used in implants include stainless steel, cobalt-chrome alloy, titanium, and nickel-titanium alloy (nitinol). Other metals, such as gold, platinum, silver, iridium, tantalum, and tungsten, are also common in many medical devices. Three types of cardiac implantable electrical devices (CIEDs) are in widespread use: pacemakers, implantable cardioverter defibrillators (ICDs), and cardiac resynchronization therapy (CRT) devices.

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