Osseointegration Applications

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Disclosures

None
History of Osseointegration…

... a Story of Losses
Ancient History

• 3000 BC the Egyptians used shaped *ivory* to replace lost teeth*

• 2000 BC the Chinese used *bamboo* wedges for the same cause*

• 2\(^{nd}\) century: a jaw of a Gallo-Roman shows an *iron* dental implant**

• The Mayans from Central America used *shells* to form artificial teeth***

* Dental Implant Prosthetics, 1e; Carl E. Misch, Ch. 3, fig 3-1
** Nature 394, 534 (6\(^{th}\) of August 1998)
*** Textbook of Oral and Maxillofacial Surgery, Balagi Ch.15, p. 301-302
In 1931 Dr. Wilson Popenoe led a team on a Mayan archaeology site and excavated a mandible.
First Evidence of Osseointegration

20 year old women, 7th century

Amadeo Bobbio, 1972

Textbook of Oral and Maxillofacial Surgery, Balagi Ch.15, p. 301-302
Modern History

1700s  Lost teeth were often replaced with teeth from human donors  
        -> mostly unsuccessful due to immune system reactions

1800s  Gold, platinum and other metal alloys were experimentally placed into sockets  
        where teeth had been freshly extracted  
        -> Long-term success rates were extremely poor.

1952   Per-Ingvar Brånemark in Sweden accidentally discovered that titanium can bond  
        irreversibly with living bone tissue.

1965   The process of purposely implanting titanium in bone for the purpose of root- 
        ing prosthetic teeth began.

1982   The Toronto Conference on Osseointegration in Clinical Dentistry created the first  
        guidelines for what would be considered successful implant dentistry.
1st Indication: Tooth Loss

**Physiologic:**
- Loss of baby teeth
  - Age

**Pathologic:**
- Disease
  - Caries
  - Parodontitis
- Trauma
  - Sport
  - Surgery/Orthodontics
Current Dental Implants

![Diagram of tooth with implant](image)

From: Australian Orthopaedic Association

MACQUARIE UNIVERSITY

THE AUSTRALIAN SCHOOL OF ADVANCED MEDICINE

Norwest PRIVATE HOSPITAL
Numbers

Implant dentistry market value

2011: 3.5 billion AUD
2020: 6.5-8.5 billion AUD
CAGR 2011-2020: 6-8%

• In 2010 1-2 million dental implants were inserted in the US
  (15-20% of all people affected by tooth loss had an implant)
• In 2020 it is estimated to be 2-4 million dental implants
  (25-30% of all people affected)

• In 2010 there were 158,000 dentists that insert implants
• In 2020 190,000 dentists do the same job

Straumann estimates; IHS Global Insight; American Dental Association, 23 Health Policy Resources Center, 2010 ADA Dental Workforce Model 2008-2030
2nd Indication: Craniofacial Loss

- **Facial defects caused by**
  - **Disease** (i.e. skin cancer, head and neck cancer)
  - **Birth defects** (i.e. microtia, anophthalmia)
  - **Trauma** (i.e. outer ear trauma, nose trauma)
Orbital
Nose
3rd Indication: Hearing Loss

**Congenital**
- Atresia
  - Chromosomal syndromes/
    - Malformation

**Acquired**
- Cerumen
- Foreign objects
- Infection
  - (middle/outer ear)
- Perforated eardrum
  - (accidental/infection)
- Otosclerosis
- Exostoses/Tumors
- Bone trauma
Bone Anchored Hearing Aid

Sound processor picks up sound vibrations

Abutment transfers sound vibrations from processor to implant

Osseointegrated titanium implant inside bone; transfers sound vibrations to functioning cochlea

… based on bone conduction …
4th Indication: Limb Loss

Diagram showing different types of amputations:
- Forequarter Amputation
- Transhumeral (above elbow)
- Transradial (below elbow)
- Shoulder Disarticulation
- Wrist Disarticulation
- Hip Disarticulation
- Knee Disarticulation
- Transfemoral (above knee)
- Transtibial (below the knee)
- Foot Amputations
Osseointegrated Upper Limb Prostheses

Thumb

10 cases 1999-2010

Prosthetic Orthotic Int 2011 June; Osseointegration amputation prosthesis on the upper limbs; Methods, prosthetics and rehabilitation 35 (2), p. 190-200
Osseointegrated Upper Limb Prostheses

Fingers
Osseointegrated Upper Limb Prostheses

Trans-radial/ Trans-humeral

10 cases 1999-2010
16 cases 1999-2010

Prosthetic Orthotic Int 2011 June; Osseointegration amputation prosthesis on the upper limbs; Methods, prosthetics and rehabilitation 35 (2), p. 190-200
Osseointegrated Lower Limb Prostheses

Trans-tibial / Trans-femoral

OPRA – Swedish
ILP/ Endo-Exo – German
Achievements

Direct structural connection between living bone and the surface of an artificial implant

Cosmetic benefits

Stable fixation

Functional benefits

Hearing

Weight Bearing

Osseoperception

Moving

Chewing

Achievements

Direct structural connection between living bone and the surface of an artificial implant

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Functional benefits

Hearing

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Osseoperception

Moving

Chewing
Contraindications for Osseointegrated Applications

There are no absolute contraindications for all of them,

however each one needs special consideration and precaution !!!


Precautions for Osseointegrated Applications

- Diabetes
- Peripheral Vascular Disease
- Lack of Compliance
- Poor Hygiene
- Osteonecrosis
- Osteoporosis
- Growing Skeleton
- Substance abuse including
  - Medication (i.e. bisphosphonates)
  - Smoking

+ other contraindications for surgery
  (haematologic problems, age, malignant disease, HIV etc.)
Precautions for Osseointegrated Applications

- Diabetes

Osseointegrated Limb prostheses
Other Applications

Precautions for Osseointegrated Applications

- Peripheral Vascular Disease

Precautions for Osseointegrated Applications

- Lack of Compliance
- Poor Hygiene

Insufficient Stoma Care -> Every Osseointegrated Application

Precautions for Osseointegrated Applications

- Osteonecrosis of jaw bone

Dental Implants - associated with taking of bisphosphonates


Precautions for Osseointegrated Applications

- Osteoporosis

Dental Implants

Precautions for Osseointegrated Applications

- Growing Skeleton

Dental Implants
Osseointegrated Limb Prostheses
Facial Prostheses

Precautions for Osseointegrated Applications

- Substance abuse including
  - Medication (i.e. bisphosphonates, chemotherapy)
  - Smoking

Up to now **no** Osseointegrated Application for

- Memory Loss
- Loss of Interest