

Cartilage Tissue Engineering

軟骨組織工程

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By 2050, WHO estimates that there will be **2 billion people over 60 years old** (據WHO預計，**2050年**地球上將會出現約**20億**年齡在**60歲**以上的人)

2 in 5 have some form of **cartilage damage** and may require **cartilage repair** (每五個人中就有兩個人有不同程度的**軟骨疾病**困擾並且需要進行**軟骨修復治療**)

Types of cartilage 軟骨種類

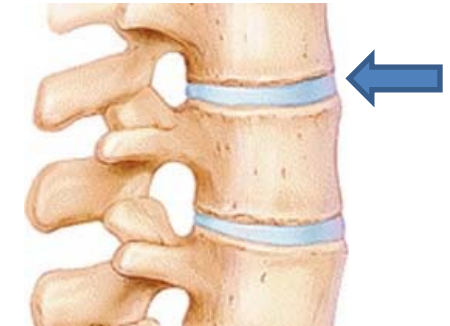
Elastic cartilage 彈性軟骨

e.g. external ear 外耳



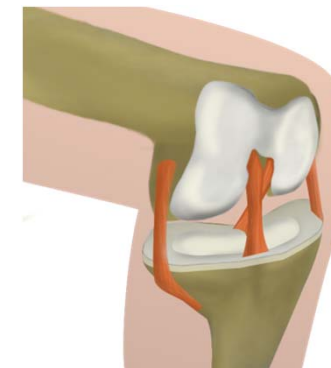
Fibrocartilage 纖維軟骨

e.g. meniscus 半月板, intervertebral disc 椎間盤



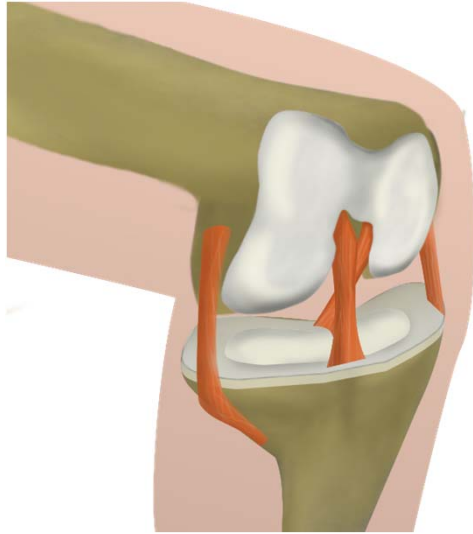
Hyaline cartilage 透明軟骨

e.g. articular cartilage 關節軟骨, nose 鼻軟骨

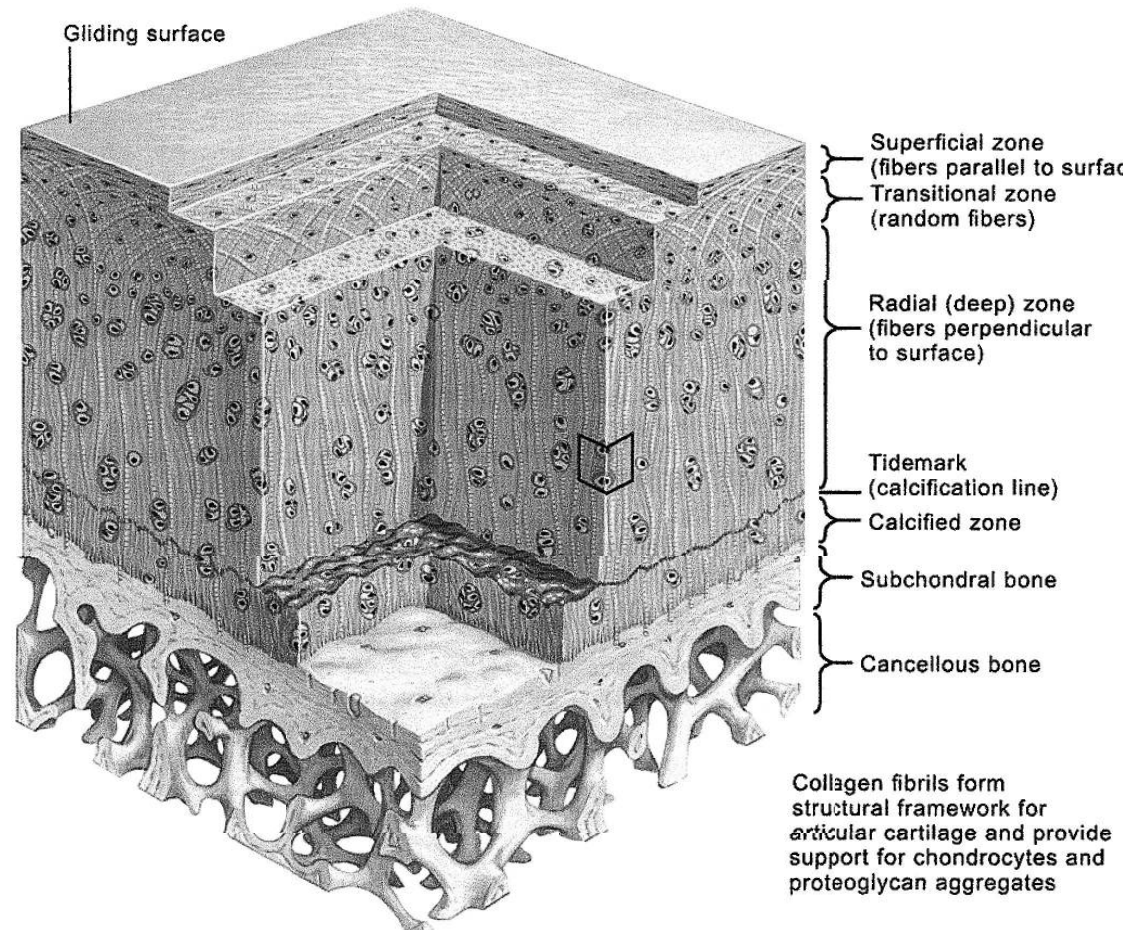


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Joint cartilage 關節軟骨組織



Healthy cartilage
健康軟骨組織



Illustrated by Drs. John A. Craig and Carlos Machado. Clin Symp. 1995;47(2)

In healthy joint, cartilage functions to protect the underlying bones from rubbing against each other
在健康的關節組織處，軟骨的作用是起保護作用，從而避免骨骼組織之間的互相磨損和沖擊

Causes of cartilage injuries

軟骨損傷的原因

- Trauma 創傷
- Sports injuries 運動損傷
- Osteoarthritis 骨關節炎
- Degeneration 退化



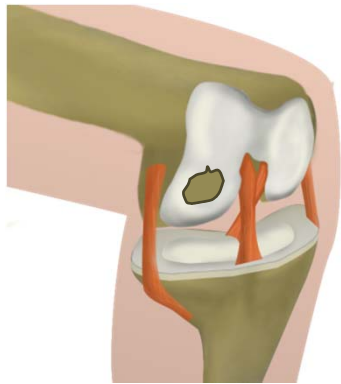
http://www.shoulderandknee.net/images/ka_kneeimg.jpg



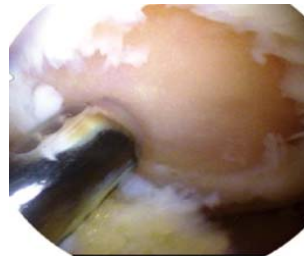
<http://pbelitewellness.com/wp-content/uploads/2014/09/Osteoarthritis.jpg>

Existing treatments for cartilage injuries

現有的治療方案



Focal Defect
局部軟骨損傷



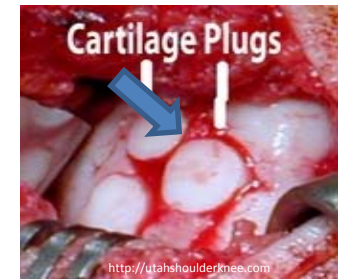
Debridement
清理創傷部位

Drilling holes 鑽孔

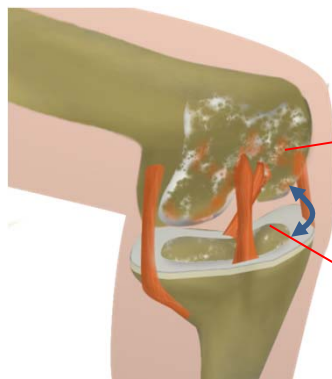


Microfracture
(bone marrow stimulation)
微創手術(骨髓刺激)

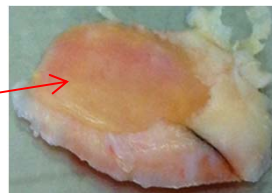
Sacrifice own cartilage
犧牲自體健康軟骨



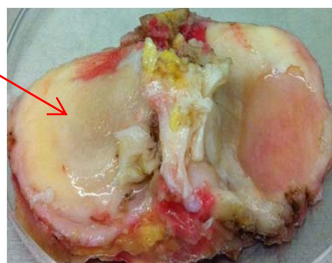
Autograft
(clinical gold standard)
自體移植(臨床金標準)



Severely Damaged
Cartilage
嚴重軟骨損傷



Clinical samples from patients
undergoing TKR
病變膝關節軟骨組織



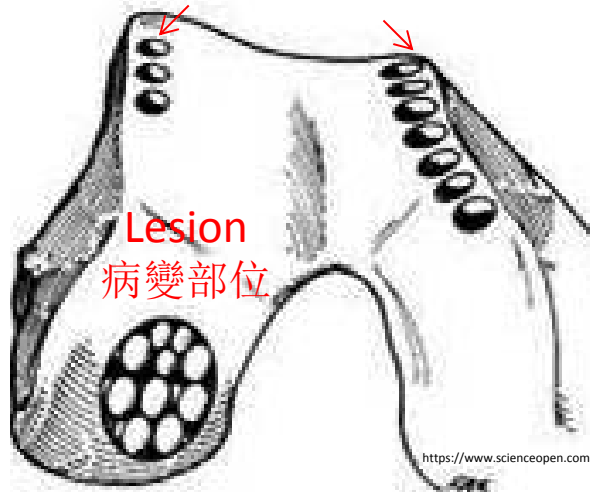
Terminal treatment 最終治療手段



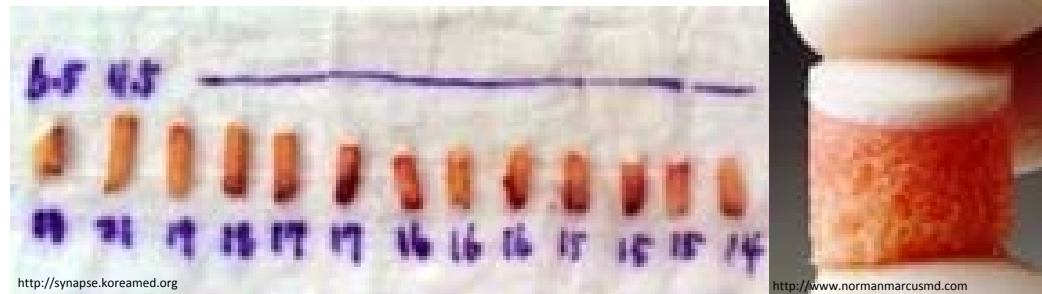
Total knee replacement(TKR)
全膝關節置換術

Osteochondral autograft (clinical gold standard) 自體骨軟骨移植(臨床金標準)

Donor sites 供體部位



Cored autografts 自體骨軟骨移植體



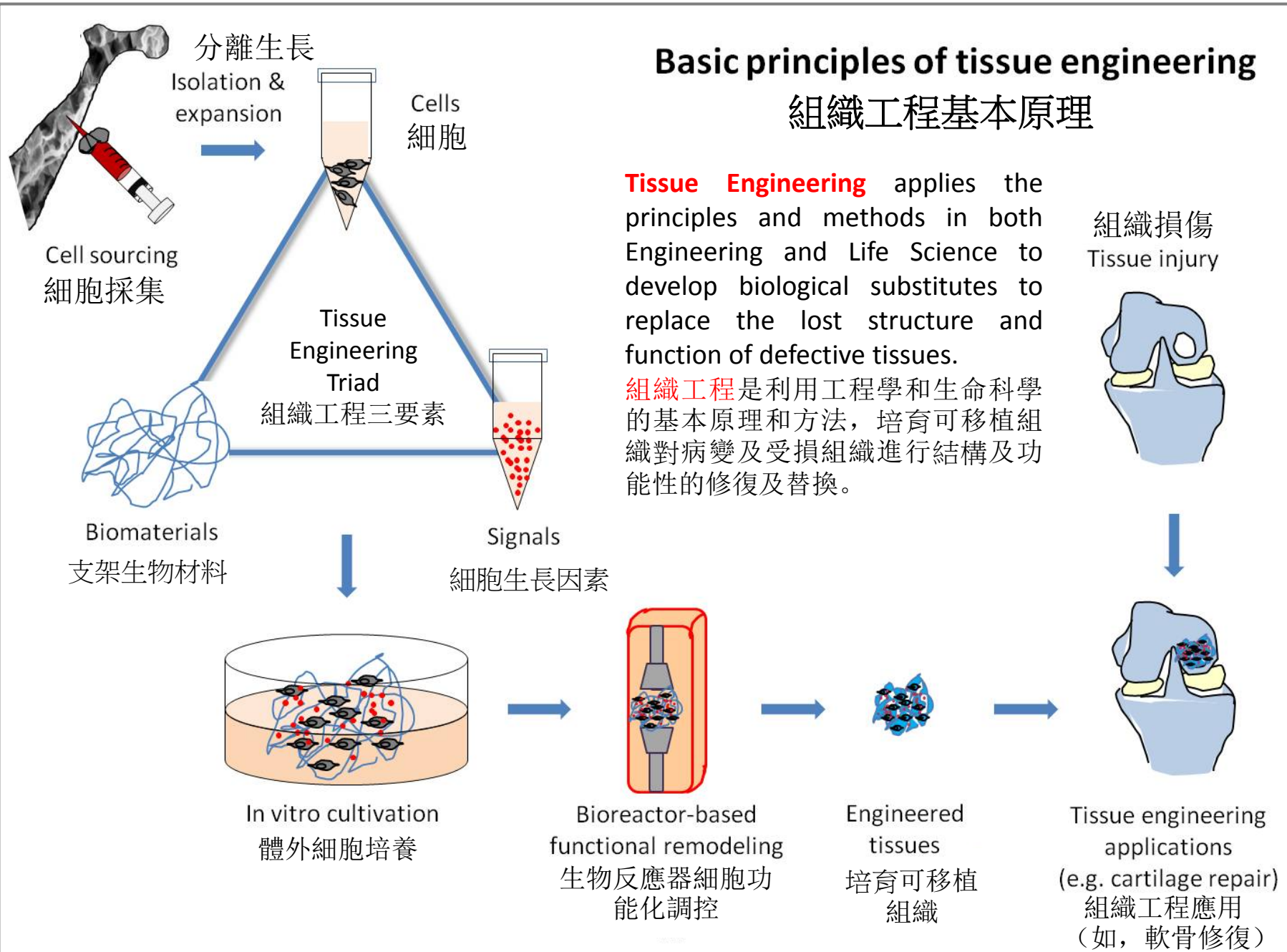
Autograft-filled lesion
自體移植軟骨組織填滿病變區



Donor sites complaints
供體部位不適

Basic principles of tissue engineering 組織工程基本原理

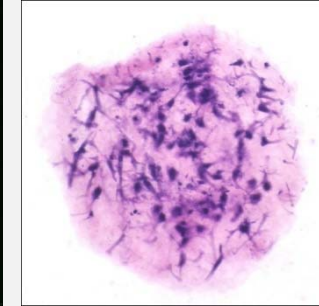
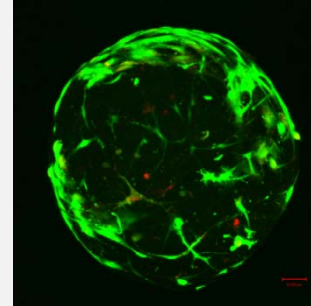
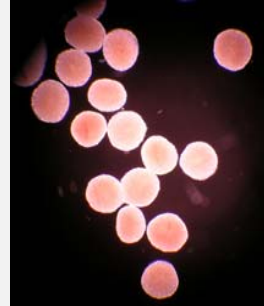
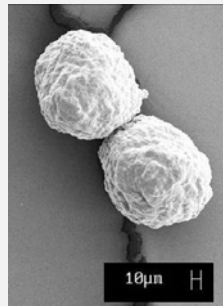
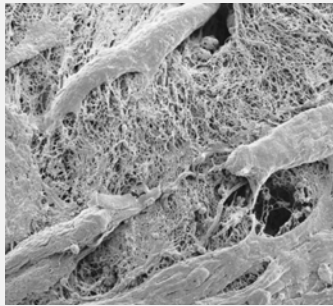
Tissue Engineering applies the principles and methods in both Engineering and Life Science to develop biological substitutes to replace the lost structure and function of defective tissues.
組織工程是利用工程學和生命科學的基本原理和方法，培育可移植組織對病變及受損組織進行結構及功能性的修復及替換。



Tissue Engineering Laboratory, HKU

香港大學組織工程實驗室

Collagen microencapsulations 膠原蛋白微囊化技術



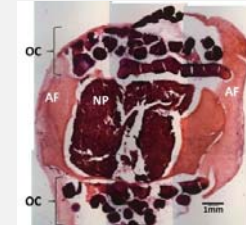
Complex tissue engineering 複合組織工程技術



Bone-cartilage
骨軟骨組織



Ligament-bone
肌腱-骨組織



Spinal motion segment
脊柱運動單元

Tissue Engineered Cartilage-Bone Plug

組織工程化的骨軟骨複合組織



**BONE MARROW
ASPIRATION**

採集細胞



**MESENCHYMAL STEM
CELLS (MSCs)**

間充質幹細胞



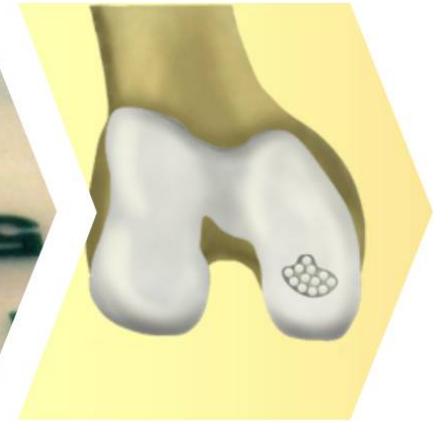
**BONE & CARTILAGE
TISSUES**

骨以及軟骨組織



COMPLEX TISSUE PLUG

複合組織



IMPLANTATION

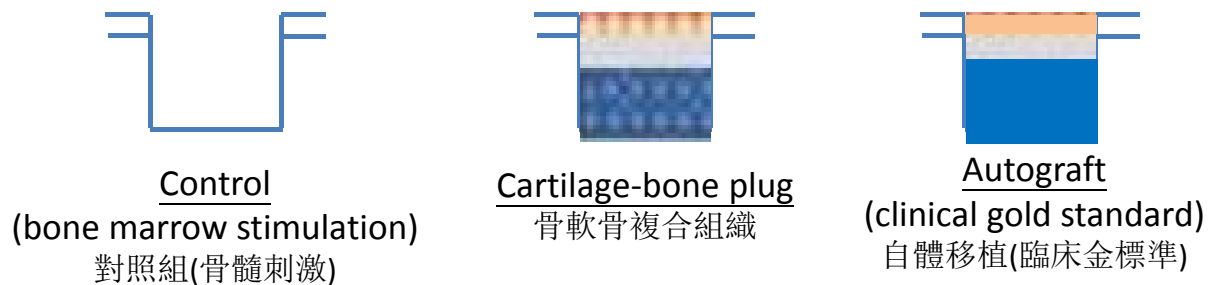
移植

Tissue engineered cartilage is comparable with autograft

骨軟骨複合組織的治療效果比美自體移植臨床金標準

Structural organization of regenerated cartilage

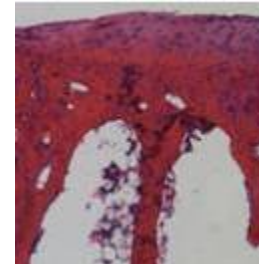
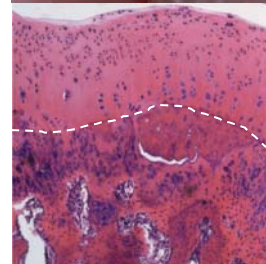
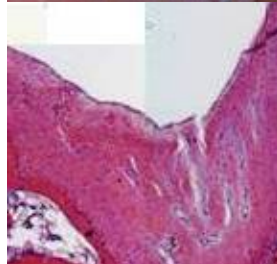
再生軟骨組織結構



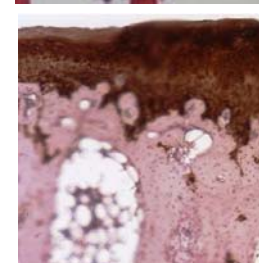
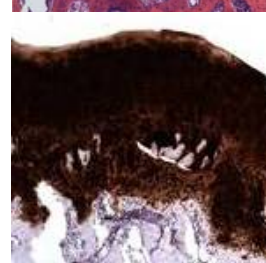
Gross appearance
外形



Cartilage-Bone organization
(H&E staining)
骨軟骨組織
(H&E染色)



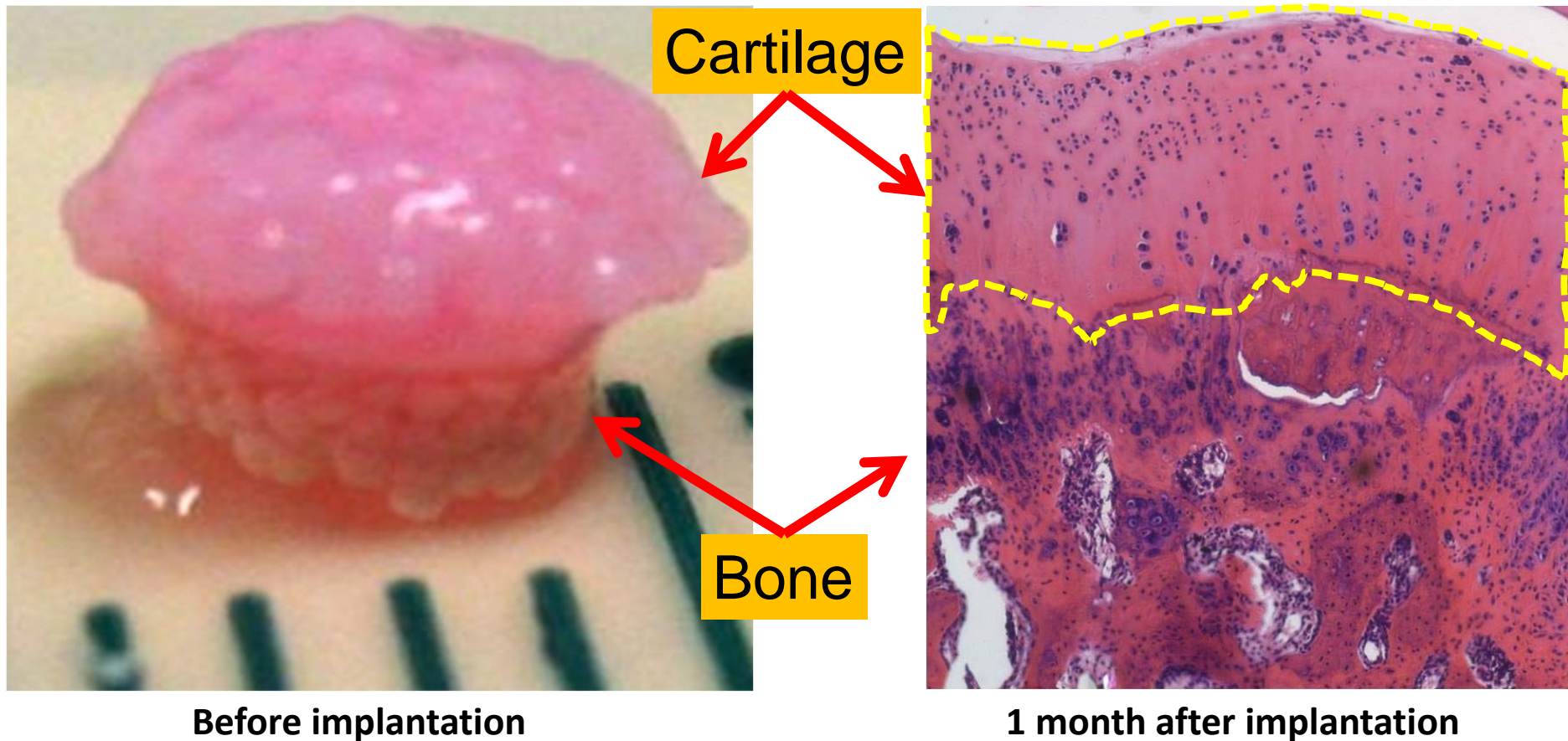
Hyaline cartilage
(collagen II staining)
透明軟骨
(II型膠原蛋白染色)



1 month post-op
術後一個月

Tissue Engineered Cartilage-Bone Plug

組織工程化的骨軟骨複合組織

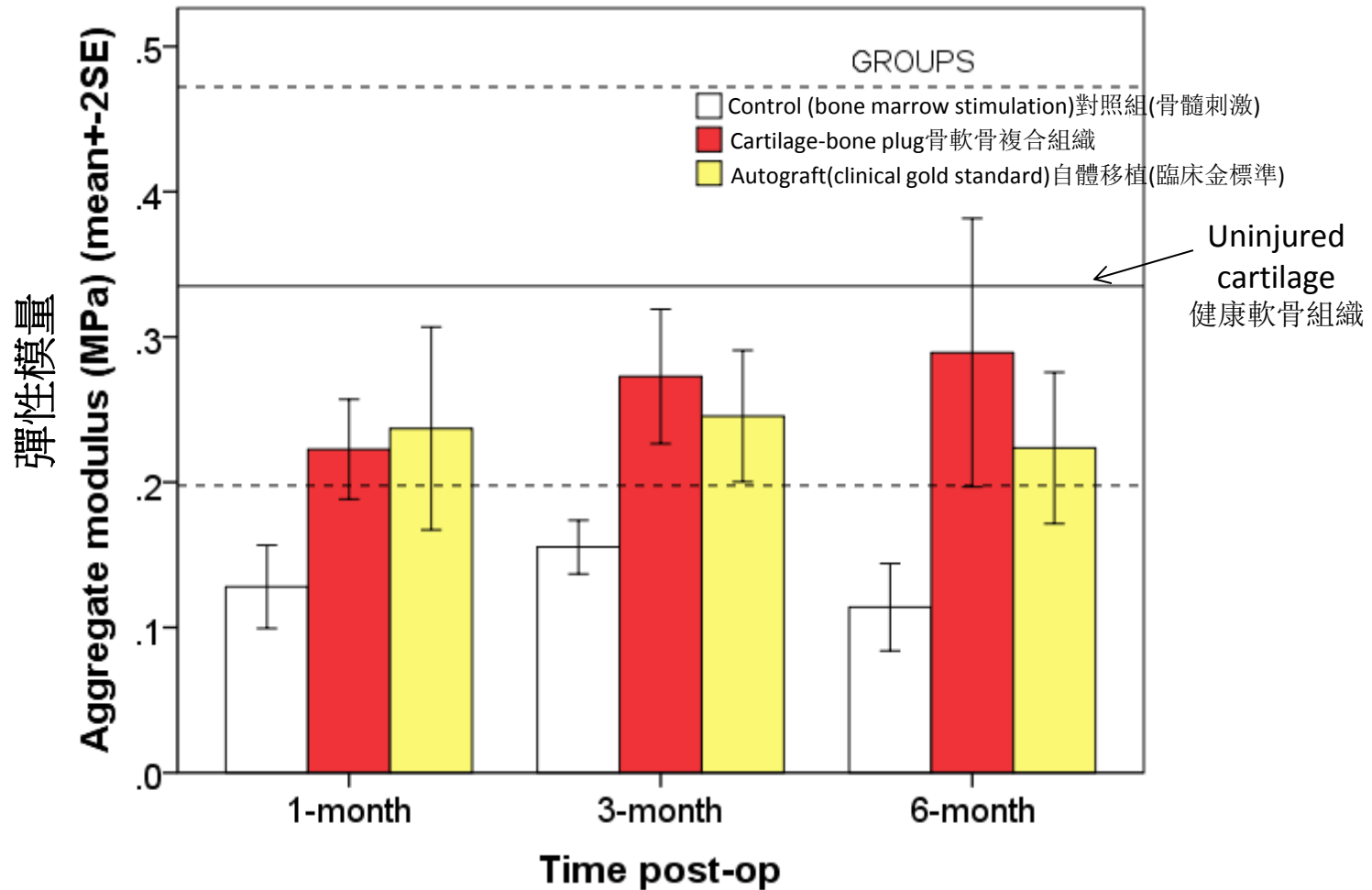


Tissue engineered cartilage is comparable with autograft

骨軟骨複合組織的治療效果比美自體移植臨床金標準

Mechanical properties of regenerated cartilage

再生軟骨力學特性

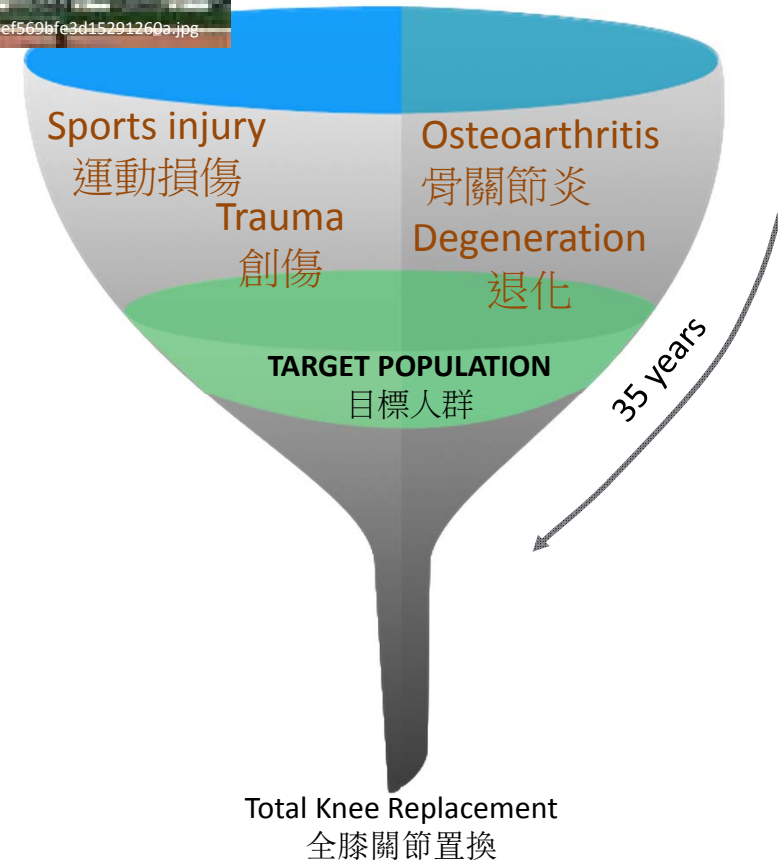


Live longer
更長壽



AND sportier
更有活力

- TKR surgeries will grow to 3.48M by 2030 in US (5x since 2010)
- 到2030年，全美全膝關節置換手術需求將會上漲到348萬 (是2010年數據的五倍)
- Higher chance of outliving the knee replacement
- 我們的技術能讓患者擁有更好地治療效果，可能不必接受全膝關節置換
- TKR getting younger, population getting older
- 需要進行全膝關節置換手術的年齡將會越來越小，而社會年齡結構將越來越偏向老齡化



Technology Startup Support Scheme for the Universities (TSSSU)

大學科技初創企業資助計劃

Living Tissues

We grow your cartilage



Living Tissues Co. Ltd.
生命組織技術有限公司

Relevant publications

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