*Principles of Tissue Engineering*

We have talked about bone grafts and GTR in last lectures   
the bone is formed subcutaneously for the first time in 1972 due to effect of BMPs   
  
the whole concept of Tissue engineering is built on researches that **mainly** done on **bone** and little bit one the **skin** (first definition 1993 )   
tissue engineering is the dentistry we practice amalgam , composite,   
porcelain , all dental filling that we use are types of tissue engineering ( **continues development** ) .

* As literatures say that amalgam by 2020 should stop being used , methacrylate that we use a lot \_as part of composite \_ has certain degree they are cytotoxicty or carcinogenicity , but the concentrations that we use in dentistry are safe . even so there is a minimal risk of it . and this happened recently .
* all this way of thinking had led to a change in the scientific community generally , and in dentistry specifically , (it started in other domains before dentistry) .

- there is an article which reflect what happened in the way of thinking , there was a very naive belief that the materials were topically inert , and it’s highly suggested now that this is **misleading interpretation** , because the materials could indeed change physically and chemically following implantation . any chemical materials change , **all** dental materials are affected by certain factors that influence it’s chemical or physical integrity So **biologically** speaking no material can be considered as inert , which means that we start to look for solutions for our biological problems .

This implied changes (a shift or evolution ) from mechanical ( surgical removal of biological issue and replace it with other material ) to biological solutions

**all the previous ( extensive procedures ) lead to the development of *biotechnology*** ,

***biotechnology*** is the summation of methods and techniques that are using as tools living organisms or their parts , it’s used in different domains , but that development  *takes time****!***

* **tissue regeneration** which the aim of our lecture ! one of the examples in 2007 an experience were a scientist implanted a sheet of cartilage cells ( stem cells ) subcutaneously of a nude mice ( nude mouse : are mouse that were modified to be immunily compromised by birth , which is a research method )   
    
  - in the experience they were able to create or reproduce the Neural cells also!! but this takes longe time .

\* The origin of Regeneration :

- **Torah** , a living creature that has 7 heads , you can’t get rid of him unless you cut all the seven heads together , if you cut only one head , it will regrow .SO no human can imagine things that are not present , this indicate that this creature could be for real , and that the regeneration originated from **nature** .like :

- **Hydra** is other example of a microscopic organism , if you cut it in to two halves each half will give the other part .

- **salamanders** also have the capacity to regenerate themselves   
  
( refer to slides )

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The aim of regeneration is not to have a perfect body , not to live an endless life , it is all about living long healthy life and it should be like that .

What is the Regeneration ?   
Regeneration is restoring morphology and function of loss tissues in a way similar to that occurring during development .

Principle of regeneration is to mimic what happen during development

There is a similar things and different things ,   
in **development** I have a migration of Neural crest cells then a cellular condensation then a spatial reorganization of cells then progenitor cells then differentiated cells so different types of tissues

In **regeneration** blood clot formation then inflammatory reaction then granulation tissue then a progenitor cells then a differentiated cells ( different turnover rates )

***In Tissue engineering*** ( which aim to approach to regeneration ) is interdisciplinary domain ,involving biological sciences and principles of engineering aiming to develop biological substitutes in order to restore , maintain and ameliorate tissue function and morphology .

it is an approach that utilizes specific **biodegradable ( which is very important** ) synthetic or natural scaffold , as well as advanced molecular techniques in order to replace tissue function . as we said last time some materials are taken from hip or other parts

* the goal of tissue engineering is functional biological structure , to achieve this goal the cells must be instructed to differentiate , and to and to receive positional cues , and to synthesize the appropriate extracellular matrix molecule in overall shape and dimensions of a diseased or missed tissue or organs , now it become complicated .
* components tissue engineering:

1. stem cells
2. scaffold
3. signaling molecules .

all dental materials that we are used are an example of tissue engineering ( composite , amalgam…etc ) but what happen is that we are moving from more primitive prosthetic approach to something that more accepted biologically!

***periodontal tissue engineering*** :

emdogain , PRP growth factor ( platelet rich plasma ) , and about bone grafting .( examples of what we are talking yesterday )

if I have a scaffold , cells and growth factors , and we said that certain factors in specific time can inhibit , on other time they can induce   
so I need ..1- time 2- an appropriate environment

could can I use the singling molecules alone ? No , due to   
1 - Short biological half-life (for ex IGF2 half life 12 hours without scaffold)  
2- Receptor-binding problems ( since the same GF can works on many types of cells )  
 3- Stability of carrier system   
4- Cell adhesion   
  
Role of scaffold :   
1 - Provide physical support Barrier   
2- restrict cell migration in a selective manner   
3-Scaffold for cell migration & proliferation   
4 -Serve as time-release mechanism for signaling molecul

there is a table in the slides about the cells component , read it   
  
to be continued ….(sheet #15 )  
  
Good luck   
  
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