Human Tooth Culture: A Study Model for Reparative Dentinogenesis and Direct Pulp Capping Materials Biocompatibility

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Organisation

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Specific Research Group or Service BIOMAT
Country Belgium
Geographical Area Flemish Region

Partners and collaborations

Aix-Marseille University

SCOPE OF THE METHOD

The Method relates to	Human health
The Method is situated in	Basic Research, Translational - Applied Research
Type of method	In vitro - Ex vivo
Specify the type of cells/tissues/organs	Human teeth

DESCRIPTION

Method keywords

Tooth Model
Ex-vivo Tooth Model
Human ex-vivo Tooth Model
Tooth Culture Model

Scientific area keywords

Pulp Biology
Tooth regeneration
Dental Mineralization
Dental Repair
Tooth Repair
Reparative Dentinogenesis

Method description

The objective of this *ex-vivo* model is to study the initial pulp-tissue reaction of the human pulp tissue to different pulp-capping materials.
Methodology: Freshly-extracted (mainly due to orthodontic reasons) healthy human teeth (impacted third molars) from young individuals (15-20 years old) are immediately collected, placed in 15-ml falcon tubes containing 5 ml of DMEM supplemented with 10% FBS, 1% penicilin/streptomycin and 1% fungizone and brought to the cell-culture laminar flow cabinet (within 4 hours). The teeth are cleaned with sterile tweezers and sterile blades and disinfected with 70% ethanol and sterile PBS. A class-I cavity (approx. 4x4x4 mm) is cut using a sterile bur at high speed under copious irrigation with sterile saline. The pulp tissue is exposed with a round carbide bur at low speed with abundant irrigation. Afterwards, the cavity is cleaned with sterile saline, gently dried with sterile cotton pellets and the selected materials are applied into the cavity. The cavity is further restored with glass-ionomer cement and a flowable composite is applied on the occlusal surface, in which a sterilized stainless steel orthodontic wire is seated, followed by 40-sec light-curing of the flowable composite using a light-curing unit with a light output of 1200 mW/cm^2. The teeth is immediately hanged using the wire in separate wells of 24-well culture plates, each containing 1.5 ml of tooth-culture medium to ensure generous exposure of the pulp tissue to the medium. The medium is refreshed every day and the teeth are kept inside an incubator at 37°C / 5% CO2 / 95% humidity for 4 weeks. Afterwards, the wire is removed and the teeth are immediately placed in 4% paraformaldehyde for two weeks to properly fix the tissue.

Lab equipment

Biosafety cabinet flow hood ;
Incubator with 5% CO2 and 95% humidity ;
Dental equipment: portable motor unit with high-speed and low-speed hand pieces and dental burs and sterile irrigation ;
Equipment for histology: Microtome, blades, glass slides, staining equipment and light microscope.

Method status

History of use
Internally validated
Published in peer reviewed journal

PROS, CONS & FUTURE POTENTIAL

Advantages

Little ethical concerns (the teeth are extracted for other reasons) ;
If done in a dental hospital, relatively high availability of human teeth ;
Relatively cheap and easy to do (except for the histological procedure) ;
It serves as a 3D *in-vitro* cell-culture model.

Challenges

If there is no dental clinic or hospital nearby the lab, it is challenging to find enough teeth ;
The histological processing of teeth is relatively difficult to perform ;
Some expertise is needed before obtaining high-quality images.

Modifications

The method can be further optimized if a kind of blood-pomp is attached to the model (instead of blood, using cell-culture medium to feed the cells).

REFERENCES, ASSOCIATED DOCUMENTS AND OTHER INFORMATION

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Associated documents

Pedano MS, Li X et al. Dent Mater 2020.pdf
Survival of human dental pulp cells...J of Dent 2019..pdf
Biodentine induces TGF-B1 release. Laurent P, About I, et al. IEJ 2012.pdf
Human tooth culture and biocompatib pulp capping. About I, Tecles O et al.Journal of Biomed Materials Res part B 2007_.pdf

Other remarks

This Human Tooth Culture model was developed and firstly published by the group of Prof. Imad About (Aix-Marseille University) :

Téclès, O., P. Laurent, S. Zygouritsas, A. S. Burger, J. Camps, J. Dejou, and I. About. "Activation of Human Dental Pulp Progenitor/Stem Cells in Response to Odontoblast Injury." Arch Oral Biol 50, no. 2 (2005): 103-8.

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