Tooth transplantation: the current status and the future development with a cryopreservation technique for teeth banking

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Auto-transplantation of tooth
: General procedure
A general procedure of tooth transplantation

34Y Male

7 missing

8 → 7

TP
General procedure of tooth transplantation
Auto-transplantation of tooth integrated with orthodontic tooth movement: an approach for periodontal tissue regeneration
Before treatment (19Y Female)

The right upper central incisor was lost with the peripheral alveolar bone due to traffic accident three weeks before the initial visit.
Orthodontic treatment for tooth alignment

A: Immediately after the transplantation
B: Elongation of the transplanted tooth
C: Overall alignment with orthodontic treatment
Completion of tooth alignment and the subsequent prosthodontic treatment

Occlusion after treatment
Changes in the level of the alveolar bone crest following the elongation of the transplanted tooth

A: Immediately before the elongation
B: After treatment
C: After two-year retention
Regeneration of the PDL and cryopreservation for teeth banking
Introduction

Many teeth, especially the premolars for orthodontic treatment, are thrown into garbage as medical rubbish, although they have healthy periodontium. These teeth are thus expected to be used as donor teeth for transplantation, which makes it available to transplant the teeth with PDL. However, damage of the PDL is an inevitable episode during extraction.

If the periodontium injured by extraction is regenerated or repaired and cryopreserved for a certain period until the clinical use, excellent outcomes of tooth autotransplantation would be achieved, providing patients with uncountable benefits in terms of sufficient mastication with their own teeth.

Objectives

The purpose of this study was to investigate PDL regeneration and long-term cryopreservation for developing a new paradigm of tooth transplantation.
Experiment 1
Examination for PDL regeneration

Experimental materials: First premolars extracted for orthodontic treatment in patients with tooth-jaw discrepancy

The PDL and cementum from the cervix to two-thirds of root length apical are removed.
Control group: no treatment
Experimental group 1: atelocollagen treatment
Experimental group 2: placement in the artificial bone after atelocollagen treatment

All experimental teeth were cultured in $\alpha$ MEM for 0 and 14 days.
Using an immunostaining technique for alkaline phosphatase (ALP), the amount of PDL outgrowth on the root surface was measured.
The amount of PDL outgrowth is shown for days 0 and 14 after initiating PDL regeneration. The outgrowth length of the PDL was significantly longer in the experimental groups than in the controls, although no significant differences were found between two experimental groups.
Experiment 2
Examination for cryopreservation of teeth

**Programmed freezer**

Programmed freezer developed in this study

Conventional freezer used in general

Water molecule before freezing

During freezing

Water molecule after defrosting

Electron micrograph of mouse masseter muscle

Programmed freezing

Conventional freezing

Freezing program

-2°C/min

-0.3°C/min

-5°C/min

-50°C/min

-20

0

30

-100
Experimental animals: Wistar strain male rats of 8-week-old
Experimental teeth: The right upper incisors

Control group: The teeth were replanted immediately after the extraction
Experimental group: After three-day cryopreservation with 5% dimethylsulfoxide (DMSO) as cryoprotectants by a programmed freezer, the teeth were replanted.
In the periodontal tissues, 7 days after the replantation, the experimental group maintained normal structures of the PDL equivalent to the controls without producing such side effects as root-bone ankylosis and progressive root resorption.
The numbers of osteoclasts and odontoclasts were almost the same in the experimental and control groups without any significant differences.
A case of tooth transplantation after PDL regeneration and cryopreservation (28Y, Female)

Before treatment

Three months after the extraction

PDL regeneration For one month

Cryopreservation

Defrosting

Drilling

Transplantation
Venture business company for PDL regeneration and cryopreservation

Dental clinic or hospital

Dental clinic or hospital

Transplantation of teeth

Extraction of teeth

Transportation

Transportation

Univ. Hospital

PDL regeneration & cryopreservation

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