frontiers FOR YOUNG MINDS

HUMAN HEALTH
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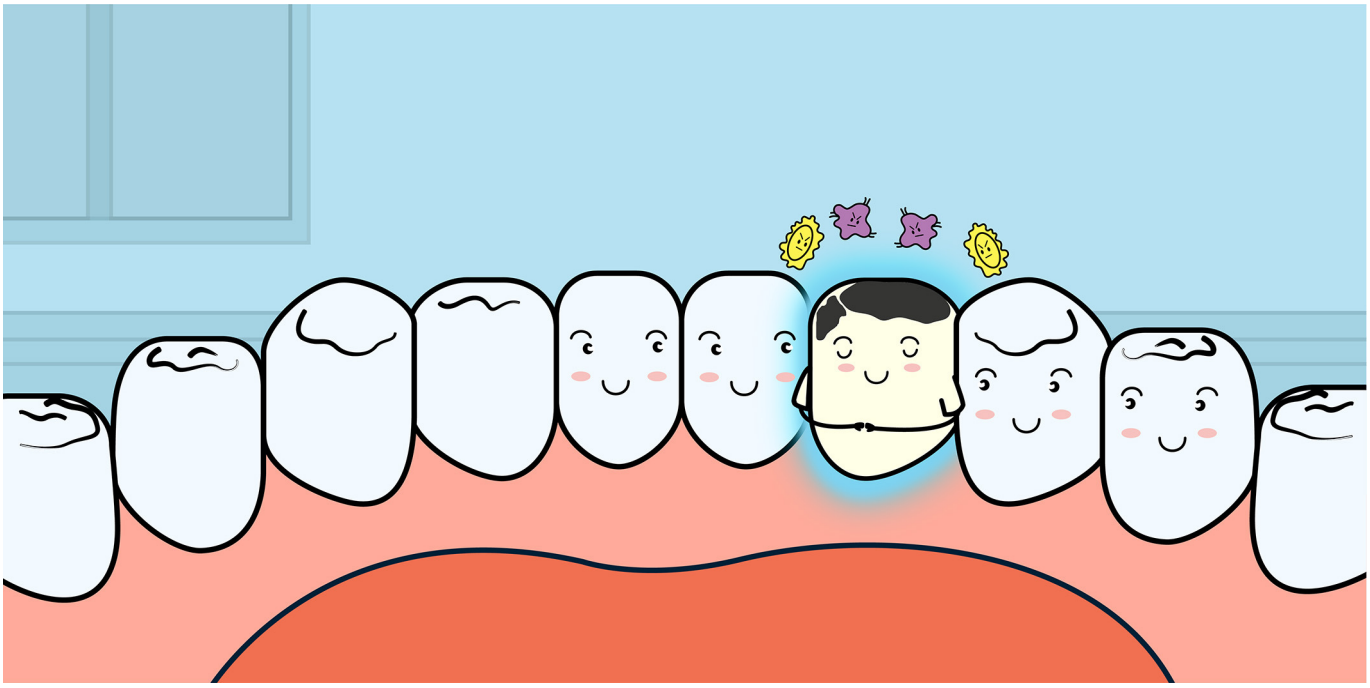

CAN WE HELP TEETH TO REPAIR THEMSELVES?

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Dental caries can cause cavities in teeth and can lead to severe pain. Decay is caused by bacteria that thrive on sweets and foods rich in carbohydrates, so they can be seen as the villains that lead to the formation of cavities. To protect themselves against decay, the teeth create a type of hard barrier inside themselves to keep decay out. The formation of this barrier is called tooth repair because the tooth cells rebuild, from within, the walls that were destroyed by decay. Scientists have tried to imitate the creation of this barrier in their laboratories, by using the tooth cells that can form various parts of the tooth. But achieving the entire process of tooth repair in the laboratory is not an easy task. Scientist and dentists still need to learn a great deal!

WHY TO RE-GROW DENTAL TISSUES?

When we see a tooth within a person's mouth, we see only part of the tooth—the rest is inside the bone. The part we see is called the crown and the part that is inside the bone is called the root. Each tooth has

DENTIN

Tissue that surrounds the tooth and has several microscopic tubes.

PULP

Located inside the tooth and responsible for bringing blood, nutrients and sensations (pain, hot, cold, etc.).

Figure 1

Tissues that make up the teeth. The enamel is the protective tooth covering, and it is the hardest structure in the body. The dentin lies just below the enamel; it is made up of many small tunnels that connect the enamel to the pulp. The pulp protects and nourishes the entire tooth. The cementum holds the tooth firmly within the bone.

CAVITIES

Holes made in our teeth by bacteria that cause tooth decay.

TOOTH DECAY

A disease in which bacteria that live in the mouth destroy themselves when we eat too much sweets and do not brush our teeth properly.

TOOTH REGENERATION

When the tooth can recover on its own from an attack, such as cavities.

a different shape, but all teeth have the same tissues and structures. The outermost structure of the tooth is called the enamel, and it acts as a protective covering. Tooth enamel is the hardest substance in the human body! Underneath the enamel there is **dentin**, formed by several tunnels that reach the innermost part of the tooth, which is called the **pulp**. In the pulp, there are blood vessels and nerves. Teeth also have a tissue called cementum, which covers the tooth root and attaches them firmly to the bone (Figure 1). In this article, we will specifically focus on the pulp tissue and dentin and explain how researchers have been studying—and trying to recreate—the process by which these tissues re-grow to protect the tooth when it is damaged.

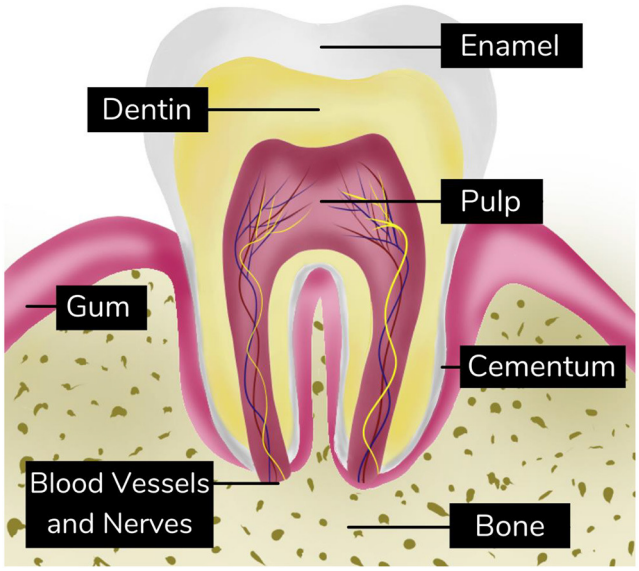

Figure 1

Cavities happen because some of the bacteria that live in the mouth can produce acids that destroy the tissues of teeth. When the cavity is close to the dental pulp, the person might feel pain. The human body is highly intelligent, and when it feels threatened by something, it creates ways to protect itself. This happens in response to **tooth decay**! The teeth try to prevent the decay from reaching and entering into the pulp. The teeth do this by forming an extremely strong barrier inside themselves, made of minerals. This barrier is similar to dentin. As scientists began to study this process, they called it **tooth regeneration**, meaning that it is the tooth's way of building new tissue to protect itself from tooth decay.

DENTIN AND DENTAL PULP REGENERATION

The protective, dentin-like barrier created by teeth to protect themselves from cavities can be seen by dentists when they take X-rays of the teeth (Figure 2). The tooth can also form the barrier *after* the

dentist has removed the decay, because the dentist uses products that help the tooth to rebuild and form new tissue. This treatment protects the tooth. Based on these discoveries, several studies are taking place to help us to better understand how teeth manage to regenerate themselves and how we can use what we discover to treat tooth decay and other diseases of the mouth.

Figure 2

Tooth regeneration seen on an X-ray and under a microscope. The microscopic image on the lower right shows the region where new tissue, similar to dentin, is normally formed to prevent tooth decay from entering the pulp (white arrow). In the X-ray image on the lower left, you can see a tooth that has regenerated to form a barrier against cavities/decay (white arrows).

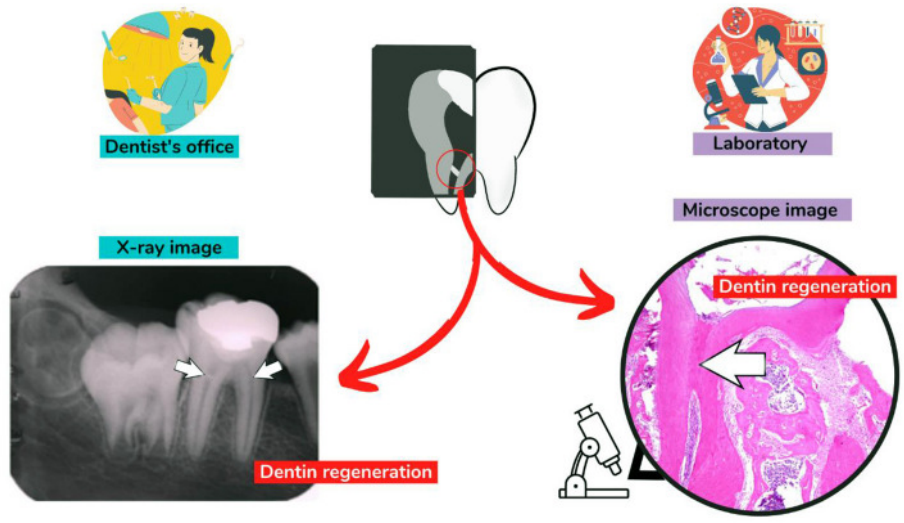

Figure 2

There are millions of bacteria that live right inside the mouth, but they are not present inside the teeth. If people do not brush their teeth, bacteria will feed on the leftover food that sticks to the teeth, and they will produce acid. The acid can eventually pierce the enamel, allowing the bacteria to enter the tooth. This can cause infection and pain.

Researchers have found that, in the pulp of teeth, there are incredibly special cells that can form new tooth parts. These cells are called **stem cells**. Stem cells are also found in other parts of the body, such as the bone marrow and fat tissue. When the teeth are invaded by bacteria, the powers of these pulp stem cells can be activated, to regenerate the teeth [1, 2].

STEM CELLS

Very special cells with super powers to multiply and transform into several other cells.

HOW ARE STEM CELLS COLLECTED

Dental pulp stem cells can be found in both permanent/adult teeth [2] and baby teeth [3]. Studies investigating stem cells from baby teeth have found that these stem cells can multiply and transform themselves into many other types of cells, such as heart, liver, bone, muscle, and several other types (Figure 3A). It is much easier to collect stem cells from baby teeth than from adult teeth, because baby teeth fall out naturally. Stem cells from adult teeth can also form several cell types.

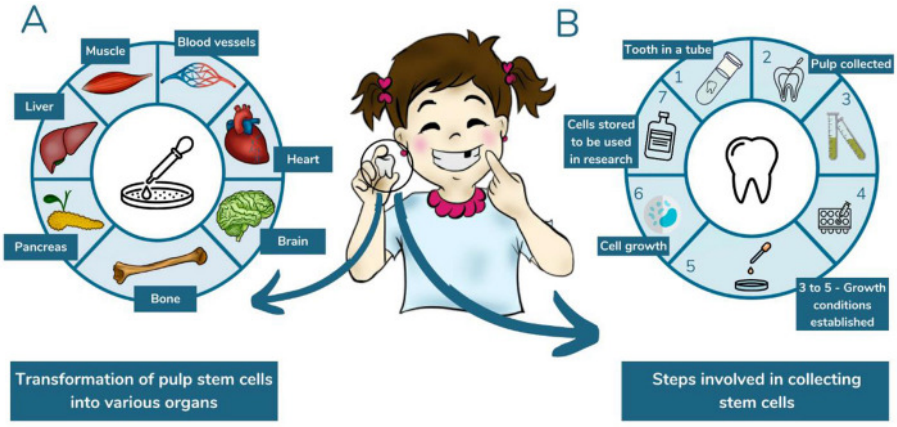

Figure 3

Children naturally lose their baby teeth as their adult teeth come in. **(A)** Dental pulp stem cells from baby teeth can be used to produce tissues of various organs of the body. **(B)** To collect pulp stem cells: (1) the tooth is placed in a tube with a nourishing liquid; (2) the pulp is collected; (3–5) the cells are placed in the conditions needed for growth; (6) pulp stem cells grow; and (7) the pulp stem cells can be stored to be used later in research.

When a tooth is donated for the purpose of stem cell collection, it must be placed in a suitable liquid and with the right nutrients, so that the cells inside the tooth do not die. The entire process takes place in a specialized laboratory, where scientists remove the pulp from the tooth and place it in the conditions that will allow it to grow and multiply [2]. Several steps are required to collect pulp stem cells so that they can be used in research (Figure 3B).

Once the stem cells grow and multiply in the laboratory, they can be used in research on tissue regeneration. These studies are called regenerative therapies. **Regenerative therapy** is a new way to re-form structures that have been lost or destroyed, such as the destruction of the tooth tissues by tooth decay [4, 5]. It is important to remember that these therapies are still in the early stages of research, and dentists do not yet perform these procedures in their dental offices.

REGENERATIVE THERAPY

Techniques that help our body tissues to recover from some type of injury suffered.

WHY IS THIS IMPORTANT?

Stem cells inside the tooth can help with the tooth-regeneration process. Repairing teeth is important to prevent you from experiencing toothache and will also help you to eat better, heal from illnesses so that people can live with an excellent quality of life. Also, studies are being conducted so that the transforming power of pulp stem cells can be used not only to regenerate teeth, but also to allow repair the tissues from other organs, such as heart, liver and brain.

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CONFLICT OF INTEREST: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

YOUNG REVIEWER

JOHNSON, AGE: 13

Hi, I am Johnson! I am 13 years old. I like doing coding, playing Minecraft and posting on Youtube. I believe that sharing knowledge online will be the trend of learning and studying. Frontier for Young Minds is the best channel for us to learn actual science. Therefore, I decided to take up the young reviewer role.

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