



Alberto Consolaro

Full professor, Universidade de São Paulo (USP), School of Dentistry,
Department of Orthodontics, Bauru, São Paulo, Brazil.
Full professor, Universidade de São Paulo (USP), Graduate Program,
School of Dentistry, Ribeirão Preto, São Paulo, Brazil.

Should deciduous teeth be preserved in adult patients? Why not?

How about stem cells from deciduous teeth? Is it reasonable to preserve them?

Abstract: A number of biological aspects of deciduous teeth can be clinically applied, all of which should be known by dental professionals. It should be highlighted: nearly 25% of the overall population has some kind of partial anodontia, which implies in the presence of deciduous teeth after the expected time in one's dental arch. Thus, a few considerations should be made regarding those teeth. 1) Once a deciduous tooth has fully developed, it gradually loses its cells as a result of apoptosis,

a natural process of cell elimination of which function has been fulfilled. Apoptosis is the biological trigger of root resorption. 2) In adult patients, deciduous teeth should not be preserved, as they promote infraocclusion, traumatic occlusion, occlusal trauma, diastemata and size as well as morphological discrepancy malocclusions. 3) Their surfaces are partially denuded and orthodontic movement speeds root resorption up. 4) Likewise, restoring or recontouring deciduous teeth in order to establish

esthetics and function of adult patients implies in speeding tooth loss up as a result of the periodontal overload posed by both processes. 5) Deciduous teeth cells are dying as a result of apoptosis, and their regeneration potential, which allows them to act as stem cells, is limited. On the contrary, adult teeth cells have greater proliferative potential, although stem-cell therapy remains as laboratory investigative unauthorized trials. **Keywords:** Deciduous teeth. Root resorption. Stem cells. Apoptosis.

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The meaning of “deciduous teeth”: nomenclature

Deciduous is an adjective that describes something that falls off, it is caducous or confined. Deciduous makes reference to the parts of plants or animals that fall off before the usual time at a certain stage of development in the life cycle as a whole. Caducous refers to something that is about to fall off, something that has lost the strength and vigor or something that has been annul and, therefore, has a limited life span. In Latin, the verb *decidere* means to fall off, to perish or to die.

Deciduous teeth are those which descend, fall off or become caducous. They are primary, temporary teeth continuing for a short time within a child’s mouth. When they become soft and fall off, those teeth undergo exfoliation, as it happens with flower petals and leaves. Deciduous teeth are preferably termed “temporary” or “primary” by Anglo-Saxon authors, as they consider “deciduous” a popular and rather lay term. Nevertheless, it perfectly describes the conditions of such teeth. Permanent teeth do not primarily take part in root resorption which is set up in all deciduous teeth, with or without the presence of permanent successors. Permanent teeth do not undergo exfoliation, but speed the process of root resorption up as they embrace deciduous teeth in their course of eruption. This is a result of the intense concentration of bone resorption mediators and hard tissues found in the pericoronal follicles.

What triggers root resorption: apoptosis!

A fully developed deciduous tooth has mineralized hard tissues (enamel, dentin, cementum and bundle bone) as well as soft tissues (pulp, periodontal ligament and gingiva). Should mineralized tissues be exposed to the connective tissue, they not only undergo resorption by clastic cells combined with other cells, but also disappear, while the enamel undergoes exfoliation within the oral environment and is sometimes carried by saliva, as a dry leaf or flower that falls off onto the ground and is taken by the wind.

However, what happens to soft tissues, cells, fibers, vessels and nerves of deciduous teeth? Exfoliation of deciduous teeth is somewhat already part of human beings. During development and growth, this process happens without any symptoms, it is natural and physiological. Thymus and thyroglossal duct undergo the same process, disappearing as we reach adulthood.

Once a deciduous tooth has fully developed, its cells are genetically programmed to release or derepress gene p53 which, in combination with other genes, controls the biochemical process of cell collapse. The cytoskeleton, the inner structure that holds the cell together, will be broken and destroyed by active enzymes, and the cell will undergo severe, gradual shrinkage.

Meanwhile, protein synthesis becomes limited and increasingly restricted. The chromatin will be arranged in disorganized lumps. The cell will have a tendency to break into several fragments or corpuscles, each one carrying a piece of cell enclosed by a cell membrane. This process is limited to a few cells – here and there – without releasing



Figure 1: Apoptosis on the root surface of a deciduous tooth. In the background, there is a landscape illustrating flowers that lose their petals or a tree that loses its leaves. In Greek, this is the meaning of apoptosis.

enzymes or without “bothering” neighboring cells or damaging tissue components. Whenever neighboring cells recognize any fragments, they aid macrophages in the region to phagocytize them.

The process of asymptomatic, natural cell elimination is best known as apoptosis, a Greek term for the loss of leaves or petals, an analogy to trees and flowers during the fall season (Fig 1). Similarly to “shedding leaves or flowers”, the cells lose pieces, or “petals”, which tend to detach from one another.

Apoptosis is also known as programmed cell death or cell suicide.

In the odontogenesis of rats and cats, as well as in cats’ and humans’ deciduous teeth, apoptosis

was first seen as a theme of Masters and Doctorate thesis and dissertation written by Lourenço.^{3,4}

Apoptosis is also part of other processes that occur in the human body, such as the elimination of cells and tissues from between fingers, thus setting them apart. It is also part of median cell cords, thus originating ducts, other hollow structures as well as channels through which secretion flows.

In deciduous teeth, apoptosis causes pulp and periodontium cells to disappear; thus exposing locally and gradually both inner and outer surfaces of mineralized tissues. This process occurs throughout the entire root and might take months or even years (Figs 2 and 3). Whenever



Figure 2: Deciduous tooth found in an adult patient's mouth, revealing infraocclusion and tooth root with preserved structure, but also revealing irregular areas of surface resorption, with imprecise lamina dura delimitation and periodontal space.

mineralized tooth surfaces are exposed, without being protected or enclosed by cementoblasts, regardless of being deciduous or permanent teeth, they tend to be naturally colonized by clastic cells, thus setting up areas of root resorption.

Should the exposed area be small or medium, permanent teeth subjected to trauma will undergo root resorption for a short period of time. However, if the area has not been contaminated by bacteria and if post-trauma inflammation ceases, neighboring cementoblasts will soon enclose the root surface, thus making the whole process stop.

For tooth resorption to occur without interruption, there must be stimuli provided by mediators of inflammatory processes and tissue stress resulting from secondary contamination or occlusal trauma.²

In deciduous teeth, although apoptosis leaves a number of root surface micro areas

exposed (Fig 4), over which clastic cells colonize, those areas tend to be very slow at reabsorbing hard dental tissues. This slow pace is determined by the extremely low level of local mediators stimulating clastic cells to act, since inflammation or local stress are absent and, therefore, do not allow mediators to build up in large amounts.

The small amount or the absence of mediators do not provide stimuli for fast resorption of deciduous tooth roots. Even so, neighboring cementoblasts cannot repopulate areas without roots, as they are genetically limited cells – most of which are undergoing preapoptosis or full apoptosis processes, without being capable of proliferating significantly.

In short: apoptosis of cementoblasts (external) and odontoblasts (internal) is the biological trigger of root resorption. Root resorption occurs in both surfaces of a deciduous tooth: inner and



Figure 3: Deciduous molars in a patient with partial anodontia of second premolars. At this stage, the case must be well planned with a combination of knowledge and experience shared by pediatric dentists, implant dentists and orthodontists, without postponing precise clinical decisions.

outer ones. Root resorption is triggered as soon as a deciduous tooth is fully formed, and does not rely on permanent successors and their tissues (Figs 2 and 3).

The role played by the pericoronal follicle in root resorption

Biological phenomena are mediated by chemical substances via cell membrane receptors. Some cytokines as well as growth factors take part in inducing apoptosis; while others speed bone and mineralized tissue resorption up. With deciduous teeth, this process is triggered by mediators present in the pericoronal follicles of neighboring and near teeth. EGF (or Epidermal Growth Factor) is a mediator that stands out for providing local stimuli for mineralized tissue resorptive processes. It is secreted by and present in the epithelia, being found

in higher concentrations in neighboring tissues. The pericoronal follicle or pericoronal membrane is an anatomical structure rich in EGF due to having a large amount of epithelia, such as the reduced enamel epithelium and the clusters of epithelial cells remaining from the dental lamina. The EGF controls the activity of other mediators also present in pericoronal follicles.

One of the surfaces of a deciduous tooth is usually facing and found to be near the pericoronal follicle of a permanent tooth (Fig 3). On this surface, root resorption is significantly sped up by the larger amount of mediators inducing and accelerating apoptosis and mediators inducing the activity of clasts, such as EGF, among others.

Even after the usual time expected for exfoliation to happen, any deciduous tooth will inevitably have root resorption triggered, regardless

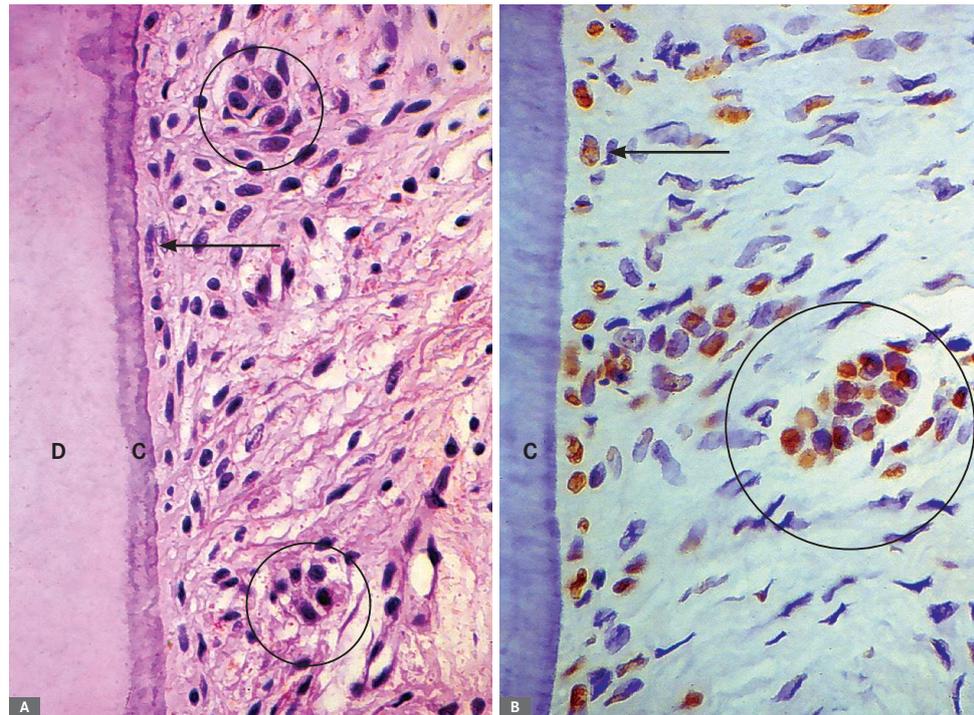


Figure 4: Root surface (C = cementum and D = dentin) and periodontal ligament of a human deciduous tooth immunohistochemically marked to identify cell proteins directly associated with apoptosis (Tunel's method in **B**). Apoptosis seems clear in cementoblasts (arrow) and Epithelial Rests of Malassez (ERM) (circles) (**A** = HE; **A** and **B** = 40X).

of the existence or not of a permanent successor near it. The onset of apoptosis and resorption of deciduous teeth do not rely on the presence of a permanent tooth and its pericoronal follicle. However, should the pericoronal follicle be near a deciduous tooth, it will speed the process of root resorption up, especially on the tooth surfaces found near or facing the permanent tooth.

A deciduous tooth without a permanent successor might, therefore, remain in one's jaw for many years; however, its root resorption began at the time its formation was complete. Should a deciduous tooth remain in one's jaw too many years without undergoing exfoliation, this means root resorption is too slow, particularly due to absence

of mediators responsible for speeding the process up and of which source usually is the pericoronal follicle of permanent teeth.

**Epithelial Rests of Malassez
in deciduous teeth die due to
apoptosis**

**This is the reason behind ankylosis,
replacement resorption and subse-
quent infraocclusion!**

Deciduous teeth undergo exfoliation thanks to cell death occurring due to apoptosis in their cementoblasts and odontoblasts, thus denuding the mineralized portion of the root and

attracting clasts (Fig 4). This process of root resorption is slow and takes place in the entire root surface because there is lack of mediators enough to speed it up.

Root resorption is sped up and unidirectional when it occurs near the pericoronal follicle of a permanent tooth, as the latter counts with a significant amount of EGF as well as other mediators that trigger bone resorption. Pericoronal follicle mediators are responsible for exfoliation of deciduous teeth via root resorption and, at the same time, for bone resorption promoting eruption.

The Epithelial Rests of Malassez are responsible for keeping the periodontal space unchanged, as they release EGF without interruption. Apoptosis also affects Epithelial Rests of Malassez cells in such a way that, within 6 to 12 months after the usual time expected for exfoliation, alveolodental ankylosis is expected to happen.

Should the Epithelial Rests of Malassez be absent in the ongoing process of bone remodeling, the bundle or alveolar bone gradually takes over the periodontal space. As a result of ankylosis, bone cells will gradually reabsorb bone and root, while irregularly taking turns with bone neoformation.

This occurs in such a way that the deciduous root is replaced by bone (Figs 5 and 6). Replacement tooth resorption in deciduous teeth is an expected evolution of cases in which exfoliation did not occur within the usual expected time.

It might sound a paradox, but ankylosis and replacement resorption of deciduous teeth

induce infraocclusion, thus freeing the tooth from receiving occlusal load (Figs 2 and 6). Without occlusal trauma induced by overload, represented by adolescent and adult occlusion, the deciduous tooth subjected to ankylosis and undergoing replacement resorption will not have the amount of inflammatory mediators responsible for speeding the process of root resorption up increased, and the tooth shall remain for a longer period of time at its original site, since most of the times the aforementioned process occurs due to absence of a permanent successor.

Reasons why a deciduous tooth should not remain in an adult patient's mouth

1st) Infraocclusion, traumatic occlusion, occlusal trauma and induced accelerated exfoliation

Occlusion will always be considered an overload to adult patients' deciduous teeth. In occlusal trauma, inflammatory mediators build up, many of which will speed bone turnover up; sometimes providing stimuli for bone neoformation, sometimes providing stimuli for bone resorption. Whenever bone turnover speeds up, the rate of root structure loss increases, thus inducing, within a short period of time, the tooth to remain attached to the underlying bone only by the cervical third of the crown.

This process rarely occurs because ankylosis leads the tooth to infraocclusion, thereby preventing the deciduous tooth from being damaged by occlusal trauma resulting from traumatic occlusion.

Clinically, should prosthetic replacement be carried out in a deciduous tooth under the



Figure 5: Adult deciduous tooth with replacement tooth resorption after alveolodental ankylosis.



Figure 6: Infraocclusion of a deciduous tooth remaining in the patient's mouth, and size discrepancy between permanent and deciduous teeth promoting displacement and irregular space closure, with proclination of neighboring teeth and interference in occlusion. Note that the deciduous tooth presents with replacement tooth resorption.

aforementioned conditions, with a view to restoring occlusion, the tooth crown will be the only structure found a month later. Occlusal overload will be established and occlusal trauma will speed the process of replacement resorption up (Fig 7).

This is the reason why we should never trust the structural stability of a deciduous tooth and perform prosthetic or crown replacement with a view to apparently restoring esthetics and function.

Such a maneuver might be useful as a therapeutic strategy employed to remove the affected tooth without the need for open surgery with bone cavities that might cause sequelae at the bone and gingival levels. One simple artifact used to have occlusion restored will be enough to trigger the accelerated process of root loss.

2nd) Diastemata and malocclusion caused by size and morphological discrepancy

Size and morphology of deciduous teeth are incompatible with those of permanent teeth. Thus, should deciduous teeth remain in one's dental arch, with consequent late tooth loss, this will lead to discrepancies that result in excess or lack of space needed to restore the site with teeth equal in size to permanent teeth, or in cases of implant placement or orthodontic movement.

Induced infraocclusion usually promotes displacement of neighboring permanent teeth distally or mesially, which results in occlusal interference (Fig 6). Size discrepancy contributes to the formation not only of diastemata, but also of undesired food impaction.

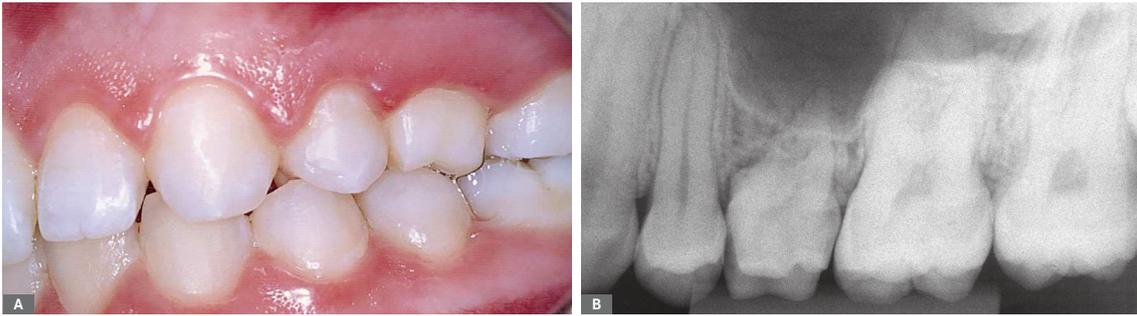


Figure 7: Occasionally, and in a special manner, some cases of adult deciduous teeth are temporarily solved with wear and movement of teeth into the space aimed at their permanent successor. Nevertheless, it should be highlighted that those are temporary solutions which might not always be the best overall option to patients.

Therefore: should we move or should we not move deciduous teeth?

a) With permanent teeth, what happens is the following:

By compressing the periodontal ligament (which is 0.25-mm thick and has 50% of its total volume made up of blood vessels), stress and/or inflammation are induced. Both of these processes are characterized by local accumulation of mediators that provide stimuli for bone resorption on the periodontal surface of the alveolar bone.

Mediators, such as cytokines, growth factors and prostaglandins provide stimuli for bone resorption at the site because they attach to or interact with membrane receptors in osteoblasts, macrophages and clasts – the set of cells known as BMU: bone modeling units.

Cementoblasts covering the root surface of permanent teeth have no receptors for local or systemic bone resorption mediators. Thus, the tooth moves throughout bone structures,

inducing resorption and remodeling periodontal tissues without causing root resorption.

In summary,¹ permanent teeth have their roots preserved due to the presence of cementoblasts destitute of receptors for resorption mediators: cementoblasts protect the roots against tooth resorption. Mediators are present, but they do not interact with cementoblasts, they interact only with osteoblasts and osteoblast-related cells.

That is the reason why teeth do not undergo root resorption when forces do not fully compress periodontal ligament vessels at the site where they act over the periodontal ligament. Whenever movement is induced by extremely concentrated, and thus intense, forces, cementoblasts might die due to anoxia. Additionally, denuded root surfaces will be subjected to resorption, even if temporarily.

b) Orthodontic movement of deciduous teeth: Why not?

In the orthodontic and/or orthopedic context, forces of any nature applied to the periodontal

ligament of deciduous teeth will trigger the same type of stress and inflammation found in the periodontal ligament. Similarly, the same mediators will accumulate and bone resorption will occur on the alveolar bone periodontal surface.

Nevertheless, once bone resorption mediators build up on the periodontal ligament, which has been compressed, under stress and/or subjected to inflammation, osteoblasts, clasts and macrophages, arranged in the form of BMU, will also be stimulated to attach to the exposed root surface of the deciduous tooth.

A number of sites on deciduous tooth root surfaces no longer have the “coating” of cementoblasts which have died due to apoptosis. Whenever mineralized structures are directly exposed to the connective tissue, they attract or promote chemotaxis for the clasts. With orthodontic movement underway, more clasts will set up as a result of stimuli provided by bone resorption mediators: root resorption will be further sped up!

Root resorption of deciduous teeth is expected to speed up when those teeth are subjected to orthodontic movement.

That is inherent to the process. Whenever a physiological structure, such as the pericoronal follicle of a permanent tooth, surrounded by bone resorption mediators, approaches a deciduous root with areas lacking cementoblasts, root resorption is sped up. Likewise, whenever orthodontic movement is started, the deciduous tooth periodontal ligament will have a high concentration of mineralized tissues resorption mediators on both sides of the affected surfaces: bone and root.

Should there be a need or an opportunity for orthodontic movement of deciduous teeth or the need to use them as anchorage units to move other teeth, or even for orthopedic purposes, one should be aware that root resorption will be sped up and, as a result, the deciduous tooth will be subjected to exfoliation earlier.

Clinicians, orthodontists and/or orthopedists planning cases of deciduous teeth involved with orthodontic movement and/or anchorage planning should ponder: Is the clinical benefit provided to the patient relevant enough so as to be worth the risk of being subjected to early, inconvenient root resorption (Figs 5, 6 and 7)?

It should be determined that forces acting over deciduous teeth do not act orthopedically, expanding the arch so as to provide more space for permanent teeth, neither prevent cross bite and other future occlusal problems. Deciduous teeth might be used as anchorage units, as it is the case of expander appliances; whenever keeping those teeth is not of great importance for the next two to three months; or, especially, when deciduous teeth have alveolodental ankylosis, with or without replacement resorption.

Except for very special cases, orthodontic movement of deciduous teeth does not prevent future occlusal problems affecting permanent teeth, it only speeds root resorption of deciduous teeth up with unpredictable consequences.

**Should deciduous teeth
be recontoured as permanent teeth?
No!**

A very common clinical question in cases of deciduous teeth found in adult patients refers

to the potential for increasing the clinical crown via prosthetic rehabilitation for esthetic or functional purposes, since they will be part of the occlusal plane.

In a deciduous tooth, adult occlusion implies forces acting over the deciduous periodontal ligament which are, therefore, excessive and traumatic, thereby causing cellular stress and local inflammation (Fig 7). The increased amount of mediators at the site will speed root resorption up and, within a few weeks or months, the deciduous tooth in question will be subjected to exfoliation.

The same line of thought applies to the potential for orthodontic movement of deciduous teeth in adult patients: there will be cellular stress and inflammation, with an increased amount of mediators at the site and accelerated root resorption. In no time, this tooth will be subjected to exfoliation.

In short, one should not plan and “believe in” restorative and orthodontic procedures in deciduous teeth remaining in adult patients. Should a remaining deciduous tooth in an adult patient require restoration, it should not be reinserted into the occlusal plane, particularly if the goal is to keep the tooth as long as possible in the patient’s mouth.

Should there be a need for pulpotomy or pulpectomy, bacterial infection must be avoided at all costs; bacterial byproducts should not spread beyond the dentin pulp surface, as it would induce inflammation of the periodontium while providing stimuli to speed root resorption up (which is already underway, but slow). Intrapulpal matter to be used must be the least aggressive and infiltrative possible at the dental structures, so as to prevent not only

periodontal tissues from being damaged, but also root resorption from speeding up.

What should be done in the presence of anodontia? Should it be kept unchanged? Should be it be recontered? Should occlusion be restored? Should the tooth be extracted?

Should implant placement or orthodontic procedures be carried out?

How and when?

All procedures have an interesting, fruitful side. Root resorption of remaining deciduous teeth in adult patients is not an exception. Despite being subjected to slow root resorption due to absence of a permanent successor, when those teeth remain in one’s mouth longer than expected after exfoliation, the Epithelial Rests of Malassez are also subjected to apoptosis. Without the Epithelial Rests of Malassez, bone will naturally approach the tooth and allow alveolodental ankylosis to happen. This is a common finding in the orthodontic office.

In addition to being smaller, the remaining deciduous tooth of an adult patient also tends to be in infraocclusion, as it has been subjected to ankylosis.

In those cases, surgical removal of this tooth will cause loss at the bone level and, from a gingival, esthetic standpoint, hinder implant placement and orthodontic movement of neighboring teeth to the extraction site.

A potential alternative taking advantage of biological knowledge to gain clinical benefits is composite resin placement on the occlusal

surface of deciduous teeth remaining in adult patients, with a view to including them into patient's occlusal plane. With occlusal trauma represented by masticatory load performed by an adult, mediator buildup at the deciduous periodontal ligament, as a result of cellular stress and inflammation, will speed root resorption up. Within a few weeks, all that will be left is the deciduous tooth crown which can be easily removed without loss at the bone level and without further surgical procedures.

Apoptosis of the Epithelial Rests of Malassez, the resulting alveolodental ankylosis of deciduous teeth remaining in adult patients and consequent infraocclusion (occurring with a view to avoiding overload of periodontal tissues) might be understood as other wonderful, puzzling manners found by nature as a way to compensate things: keeping a deciduous tooth in one's mouth longer than expected, in the event of partial anodontia of permanent successors!

Presently, implant-supported prostheses and orthodontic movement can be used for space closure. Clinically, professional intervention will yield better outcomes for anodontic patients. Nevertheless, nature did count on the progress of Dentistry at the time it idealized the human body!

Partial anodontia of permanent teeth affects, on average, 25% of the overall population. Those cases must be diagnosed as soon as possible at an early age, and the child's parents or guardians must be immediately informed and called upon to make a decision.

Pediatric dentists, implant dentists and orthodontists must work together, study the case

regarding its prospect of craniomandibular growth, and come up with a follow-up schedule in order to decide whether they will keep space for future implant placement, to be performed as soon as the patient reaches adulthood, or whether the deciduous tooth will be extracted, with subsequent orthodontic space closure.

Diagnosis and planning must not be postponed. They must be followed, cleared up and have their steps consistently applied at the scheduled time. One should not encourage deciduous teeth to be kept in an adult patient's mouth, as this will typically lead to unsatisfactory, late consequences. Additionally, there are no benefits to be gained if they are kept in an adult's mouth for an indefinite period of time.

How about using deciduous teeth as a source of stem cells: Is it reasonable to keep a deciduous tooth in one's arch for that purpose?

As soon as deciduous teeth are formed, their cells immunohistochemically reveal that they are gradually dying due to apoptosis. Apoptosis is a process of cell death controlled by the cells themselves, resulting from dysregulation of gene p53, which initiates a series of biochemical intracellular phenomena that result in cytoskeleton breakage and degradation of cell nucleus and membrane.

Within a few hours or days, that cell in which gene p53 has been derepressed shrinks and begins to lose fragments, as if it were a flower that loses its petals or a tree that loses its leaves. As odontoblasts and cementoblasts die here and there, they leave deciduous teeth surfaces with small, numerous, increasing cell-free areas.

Odontoblasts and cementoblasts protect odontogenic mineralized tissue surfaces against clasts, cells typical of mineralized tissue resorption, regardless of their nature.

The natural future of all cells of which deciduous teeth are made up is apoptosis, as a means of elimination!

At surface and cell-free areas subjected to apoptosis, the cementum and dentin will receive and have clasts attached, thereby inducing root resorption. This process occurs regardless of root region, whether apical, medium or cervical. Indeed, root resorption is initially triggered, initiated, induced or provided by apoptosis of cementoblasts and odontoblasts of deciduous teeth.

Apoptosis is one of the most elegant and impressive mechanisms performed by the human body to eliminate undesirable cells, such as those which have reached their functional peak, have accomplished a specific mission or have become rebellious or defective and, therefore, are willing to attain autonomy and, whenever surviving, create specific, cancerous clones.

All cell tissues are subjected to apoptosis; without it, we would have a much briefer life.

Although root resorption occurs simultaneously in all root surfaces and regions, including the inner surface, it is usually sped up and directed towards a few specific areas and situations as a result of being near a permanent successor. The pericoronal follicle of a permanent tooth is rich in a growth factor pertaining to the epithelia, including the reduced enamel epithelium and the clusters of epithelial cells remaining from the dental lamina present in its connective tissue.

The reduced enamel epithelium, which has already formed the enamel, is now steadily attached to the enamel and it is nurtured by a capsular connective tissue. Together, they form the pericoronal follicle. The major structure responsible for tooth eruption, as it is rich in EGF (epithelial growth factor), is the pericoronal follicle. It induces epithelial cell proliferation with a view to keeping the tissue structure, as it is constantly renewed. Meanwhile, many EGF molecules act over the surrounding bone tissue, thereby inducing pericoronal bone resorption and digging way for the emergence of the tooth into the oral cavity.

While the pericoronal follicle, along with its mediators “controlled” by the EGF, promote pericoronal bone resorption in the course of tooth eruption, they speed up slow root resorption when they approach a deciduous tooth. As a result, resorption plans of deciduous roots are established towards the region where the permanent successor is.

Follicular tissue will always be between a permanent successor and a deciduous tooth when they are near one another. On one side, it will adhere to the enamel through the reduced enamel epithelium; whereas on the other side, it will adhere to the connective tissue rich in clasts, on the interface with the deciduous tooth surface. Root resorption is not induced by the presence of a permanent successor, but the latter is indeed responsible for speeding it up and moving it towards a single direction!

How about storing deciduous teeth stem cells?

In order to raise funds, scientists have to convince referees that their research projects are

worth it. Those referees are usually university professors who also rely on the same type of fund provided by government agencies and private companies. Thus, competition is tough. A worldwide common means of putting pressure on referees is by anticipating projects or preliminary outcomes of initial trials and disclosing potential applications and benefits to the media, thus producing “truths and/or needs.”

An example of such pressure posed by the media is stem cells. Ordinary people believe that stem cells can be routinely used in patients and are a treatment modality employed in Medicine. However, there is no country in the world allowing any stem-cell therapeutic protocol to be used in patients. All outcomes and potential benefits disclosed are either experimental or authorized trials, but they do not consist of a treatment protocol.

In clinical practice, stem cells represent hope. The risks patients might be exposed to still need to be further investigated.

For this reason, protocols cannot be established yet. Among such risks, there is the growth of tumors resulting from stem cells implanted in one’s organism. Despite all restrictions and limitations, some people and some companies spend and make money with storage of cord blood and bone marrow stem cells. Lately, cells collected from exfoliated deciduous teeth, which are replaced by permanent teeth, have also been stored.

None of stem cells companies and banks can guarantee that those cells will be feasible or useful for a more than a few years. A strong argument put forward by those companies to convince people is that, in

the future, stem cells might be found very useful. In other words, they are explicitly and legally offering hope.

Using cells collected from deciduous teeth as a source of stem cells represents an incongruity: they do not have a great potential to originate new cells, as they are genetically programmed to die, with structural fragmentation. The genes activated in those cells do not have the potential for regeneration required for them to act as a new source of young cells. A few studies report that cell markers reveal such low potential.⁶

Teeth might and have been used as a source of stem cells for studies, provided that such cells are collected from permanent teeth recently formed or under development, as it is the case of third molars or other permanent teeth subjected to extraction, but not from deciduous teeth. Research using stem cells extracted from deciduous teeth must have their outcomes thoroughly assessed. Should they be positive, they must be explained on the basis of other principles, not on the basis of a new cell population originating from senescent cells.

Individuals not older than 15-16 years of age have their third molars not yet completely formed; those teeth are indeed dental embryos full of stem cells. Third molars could be extracted between 10 and 12 years of age, and might as well be a rich source of stem cells, unlike deciduous teeth with their cells on the verge of or already under apoptosis! A number of research groups, nationally and internationally set up, have researched the potential of deciduous teeth-derived stem

cells to grow other types of cells, including neurons, namely:

1. At Instituto Butantan, located in São Paulo, deciduous teeth-derived stem cells have been employed in human beings by studies¹ aiming at restoring one's cornea. Nevertheless, they are experimental trials of which outcomes are not expected to reach the overall population in a near future. The technique employed to collect and treat deciduous teeth pulp cells allowed them to grow in laboratory. Such studies began in 2004.
2. At Universidade de São Paulo (USP), a research study¹ reported that adult teeth stem cells receded to the induced pluripotent stage (iPS), presenting features similar to those of embryo stem cells. The therapy aimed at treating autistic children by means of a noninvasive method. Blood collection and biopsy might be traumatic and effortful for children. iPS skin cells are exposed to light and other environmental contaminants and are, therefore, subject to mutation. Tooth cells, however, remain protected. Nevertheless, the researcher claimed that it is way too soon for outcomes to be extrapolated to human beings.
3. At Universidade Federal de São Paulo (UNIFESP), research on third molars considered those teeth as a major stem cell source capable of growing tissues and regenerating disease-affected body parts. The research was primarily developed at the National Institute of Advanced Industrial Science and Technology Japan;⁵ however, at UNIFESP, since 2007, researchers experts in Cell Biology and Genetic Therapy were able to

transform third molar cells into bone cells of the mouth or other body parts.

Convincing parents to store tissue cord blood and/or bone marrow stem cells of their children with hopes of using them in the future is understandable; however, convincing them to keep aged cells under apoptosis, collected from deciduous teeth, and using them as stem cells is a difficult task. Furthermore, it is even more complicated to convince adult patients to keep deciduous teeth with the same purpose.

The media, as well as a few researchers and entrepreneurs, have systematically insisted on deciduous teeth as being a source of stem cells. This is probably a result of lack of in-depth biological knowledge and research on deciduous teeth which, in general, are conducted by non-dental professionals. Change the focus from deciduous teeth to third molars and enjoy data collection!



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