Avulsed teeth.
Other therapeutic resources.

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Medical Record Nº 11
Age: 13 years old.
Gender: Male.
Birth Date: 27/09/1996.
Blood Group: B+.
T.P.: 11 y 21.

Consultation motive:
The patient was derived from the Emergency Department of the Guard of the Rosario's Faculty of Dentistry. He had had a traumatic event at school. He was treated on emergency in the Guard and then derived to the specialist to assess the affected teeth. Although he had no pain the radiographic images showed disease and mobility in the 11 and 21 teeth.

Dental history:
The patient and the responsible adult (father) reported that he was running in the school playground, struck his head with a mate and lost consciousness. As a result he hit his face on the schoolyard ceramic floor. The 11, 21 and 22 teeth were injured by displacement. The 11 tooth: avulsions, the 22 intrusion and in the 21 the intrusion was complicated with an oblique crown fracture of the incisal edge without pulp exposure.
He also had soft tissue injuries: cut on both lips.

At the time of the accident it was a teacher who reintroduced the avulsed tooth after immersed it in milk. In the emergency department, teeth 21 and 22 were descended, repositioned and splinted. After a month the splint was removed. He was referred to the Endodontic specialty due to the mobility the 21 and 11 teeth had and the radiographic images both had.

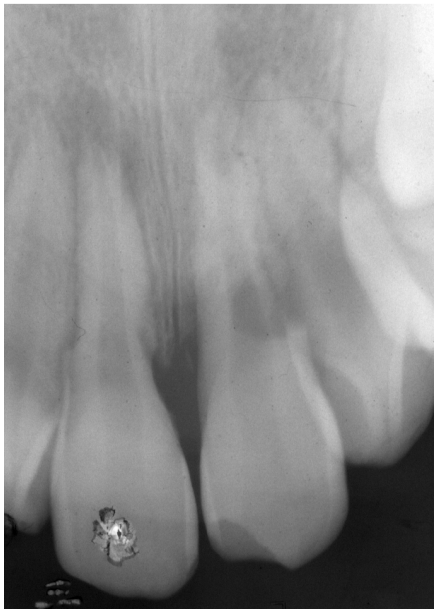
Presumptive diagnosis:

- **11:** Pulp death caused by rupture of the neurovascular bundle at the apical level caused by avulsion of the piece. And tooth movement.
- **21:** Pulp death produced by the breaking and crushing of the neurovascular bundle, with periapical processes and the external dentine-cement resorption apical and lateral.

Clinical Test:

1. **Extra-oral inspection:** It didn't show tumours or adenopathy, or fistulas. There wasn't a colour change or asymmetry.
2. **Intra-oral inspection:**
   - Hard tissue: the 11 tooth had enamel cracks in the coronary surface. In the 21 tooth it was observed an oblique fracture of enamel and dentin in the incisal edge of the coronary surface without pulp compromise. They didn't have cavities or fillings.
   - Adjacent soft tissues: without tumours, fluctuation, fistula, or crepitation. Periodontal test normal.
   - Both pieces with mobility.
   - There was no pain on percussion or palpation.
   - The patient showed marked protrusion of the entire upper-anterior field, narrow palate and open bite (increased overjet) did not have lip closure, all due to his status of mouth breather. Factors predisposing to injury.

Diagnostic images:



An orthoradial X-ray image was obtained from the affected area. In this periapical radiograph the 11 teeth was observed with a young pulp chamber and an enlarged root canal, an immature apex with apical reabsorption and a widening of the periodontal apical and mesial lateral space. There was a diffuse osseous radiolucent image in the periapical zone. The alveolar cortical did not maintain its continuity at the periapical level. It was also observed external resorption in the neck of the tooth, especially in the mesial surface.
In the 21 tooth, it was observed a young pulp chamber and a widened root canal, an immature apex with apical resorption and a widening of the periodontal apical space and lateral distal. A radiolucent image was seen in the cervical third of the root, extending from distal to the centre of the vestibular face of the root, overlapping the image with the duct one. It was an image of an external root resorption which seemed to communicate the root canal with the periodontium. At the coronary level there was loss of substance, a fracture involving enamel and dentin without pulp compromise.

In the embrasure of both pieces it was noted a significant bone loss in cervical (loss of marginal bone support), leaving uncovered part of the cervical third of the roots.

Final diagnosis:

The **avulsion** is the most serious periodontal ligament injury; the tooth is completely displaced out of the socket, causing the immediate break from all of the periodontal ligament fibers, blood and lymphatic vessels and neurovascular bundle. They cause damage to the root cementum and the alveolar bone due to the detachment of the periodontal fibbers.

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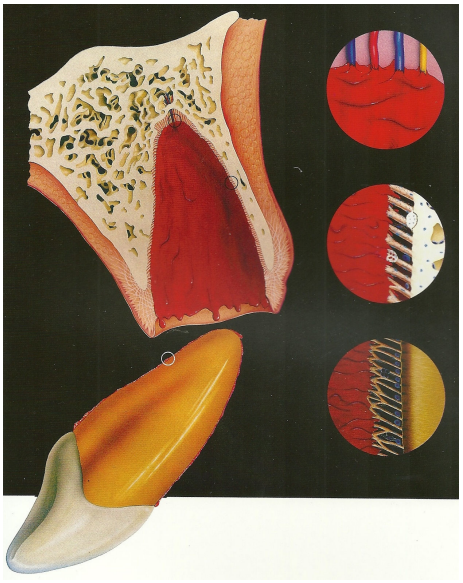


The abrupt and complete interruption and the neurovascular blocking cause complete degeneration of the entire cell population. On dental pulp cell death is inevitable. In incompletely developed apices revascularization can be expected. On the support apparatus, the maintenance of the vitality of the periodontal fibers ensures the prognosis. Treatment is directed at restoring blood supply by the reimplantation of the avulsed tooth, so these injuries must be addressed as quickly as possible.

Extraoral time, the storage medium, the type and length of splinting, the status of the root development and the Endodontic management are key factors in long-term prognosis of the avulsed tooth.

In a dry environment, the death of the 50% of periodontal ligament cells occurs after 30 minutes. After one hour almost no viable cells remain, consequently, the dry storage critical time is 20 to 30 minutes. After two hours in an inadequate dry environment the necrosis of the periodontal ligament occurs. In these cases it should be very gently removed with a scalpel or a curette and try to denude the cement, as it is a natural protector against the process of resorption, or you can remove the necrotic periodontal ligament, usually infected, soaking the tooth in sodium hypochlorite for 30 minutes.

The immediate treatment of an avulsion is **re-implantation**. When the avulsion occurred minutes ago the procedure is as follows:

- → If the tooth is clean, it should be immediately put in cold milk, saline or distilled water (storage medium), where it would remain until the correct practice were done to the patient and the socket care.
- → If the tooth is dirty, it must be washed with saline and then placed in one of the recommended solutions.
- → Then in both cases, it is taken by the crown. It should not be scraped, brushed or dried. It should be handled as little as possible.

The speed in which the tooth goes back to the socket within the alveolar bone and the storage media are two basic factors to determine the characteristics and intensity of the root resorption that fatally would happen.

There are many **conservation mean** used to maintain the vitality of the cells of the ligament attached to the avulsed tooth. Among them are:

- → Saliva.
- → Saline.
- → Milk.
- → Culture means for cells and tissues.
  (Eagle's medium, Viaspan, Hank's balanced salt solution),
- → Propolis:
- → Restorative electrolyte drinks (Gatorade).
- → Preservative solutions for contact lenses.
- → Green tea extract.
- → Coconut water.

The milk is an excellent conservation mean, it has the pH and osmolarity is compatible with living cells, it is relatively free of microbes and, above all, it is almost always available on the site of the accident. Although it does not provide conditions to produce the restoration of cell morphology or its differentiation and mitosis, milk prevents cell death. It is an appropriate storage media for up to 6 hours.

The use of cell culture media not only keeps cells alive, but also provides conditions for cell proliferation of the live segments of the ligament, so that the bare parts or with mortified ligament could be coated over the root surface. With these it is possible the store for long periods (from 24 to 96 hours). But they are media that are not available to the patient and it is unusual to have in the doctor's office.

Propolis has antibacterial and anti-inflammatory capacity.

The use of green tea extract has been reported to have significant anti-inflammatory, antioxidant, anticarcinogenic and to prolong the survival of the ligament cells, in a similar way to Hank's balanced solution and more than milk.

Reimplantation steps:

A tooth that was stored will be taken by the crown between the thumb and index finger and slowly inserted it into the socket. There is a substance (Emdogain) that showed that it can stimulate the regeneration of periodontal ligament, from stem cells, placed in the socket prior to reimplantation. You do not need excessive pressure because the tooth seems to want to return to its place. The tooth must be kept under a slight digital pressure for 2 or 3 minutes. After that time, it will be appropriately located and without a tendency to a new extrusion. At that time, the adjacent teeth must be splinted.

Although the tooth has been out of the socket over than 2 hours and in a dry environment, the reimplantation will be try the same because despite these adverse conditions, the possibility of resorption or ankylosis will allow the tooth to remain for some years.

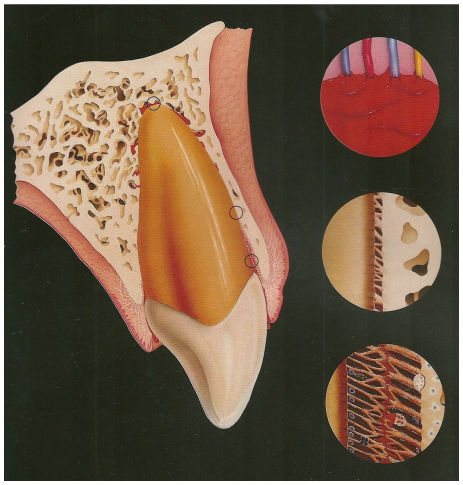
The tooth should be placed in sodium hypochlorite for 30 minutes to remove the layer of necrotic periodontal fibers and in a citric acid saturated solution for 3 minutes to generate roughness on the surface of the cement for the insertion of new periodontal fibers, then it is washed with saline and dipped into a solution of 2.4% Sodium Fluoride for 5 minutes and finally it is left 5 minutes in a solution of 1mg/20 ml doxycycline. The conventional endodontic treatment and the reimplantation must be done then.

After reimplantation the tooth should be splinted with a flexible splint, no more than 10 days, as there is a significant relationship with the occurrence of ankylosis (including inflammatory resorption) and a **longer splinting**. This can be done with a cord or orthodontic wire of 0.25 mm or 0.30 mm and composite resin or fiberglass bands. The cord or the wire is fixed with composite resin placed in the third incisal of the vestibular faces of the traumatized tooth and the adjacent ones. The time for the splint is of 2 to 3 weeks. Occlusion is controlled to prevent interference. The hygiene of the areas must be strict. It suggests the use of chlorhexidine mouthwash for a week to reduce pollution at the gingival sulcus.

The immobilization prevents vertical displacement of the tooth, but it allows tiny horizontal movements that contribute to periodontal ligament repair.

Oral Antibiotics are given and if needed, painkillers. If the patient is not protected against tetanus vaccination is recommended.

Intrusion is the displacement of a tooth into the alveolar bone. This injury is accompanied by a comminution or fracture of the alveolar socket.



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It represents the most severe injury because of the damage to anchor gingival and periodontal ligament and bone bruising and injury to epithelial root sheath of Hertwing (in immature teeth case). In addition, the intrusive displacement carries bacteria from the plaque that covers the crown into the wound site. All these events, individually or in combination, have the potential to cause healing complications.

Due to its locked position in the bone, most intruded teeth are not sensitive to percussion and very firm in their socket. The extent of the intrusion can vary from 1 mm to a total immersion of the displaced tooth. Percussion testing produces a high pitched metallic noise, similar to that shown in ankylosed teeth.

Treatment:
Teeth with immature apices often can spontaneously re-eruptioned. This would prevent more damage to periodontal injury, a factor that optimizes the marginal bone healing. They can be loosened with forceps on the first date (to release the mechanical grip of the bony walls of the root surface) and then re-eruption is expected. This takes approximately 6 months for total eruption. If there is no evidence re-eruption after a month they can be loosened with forceps and then orthodontics.

A reliable treatment is the eruption through orthodontics. It must be done at a pace consistent with marginal bone repair. In cases where it is fully intruded it will be partially repositioned with forceps in order to place the orthodontic devises.

Another option is the surgical repositioning. After local anesthesia, the tooth is pressed with forceps (preferably proximal) and brought to its normal position. Then the displaced palatine bone and labial are repositioned with digital pressure and gingival lacerations are sutured. A splint is applied and kept for 6-8 weeks.
This procedure is indicated in multiple intrusions as well as in cases where the tooth is intruded more than 6 mm.

A late complication after luxation injuries in permanent teeth is **root resorption**; it can only be seen radiographically. It can be classified into:

1.1 Superficial resorption (repair related resorption): the root surface which show superficial resorption lacunae repaired by new cementum, presumably representing localized areas of damage to the periodontal ligament or cementum. In contrast to other types of resorption, surface resorption is not progressive, is self-limiting and shows repair a spontaneous repair. Due to their small size they are usually not disclosed radiographically. However, it is sometimes possible to recognize small excavations on the root surface delineated by a normal width lamina. When visible, these resorption cavities are usually confined to the lateral surfaces of the root, but many can also be found apically, resulting in a slight shortening of the root.

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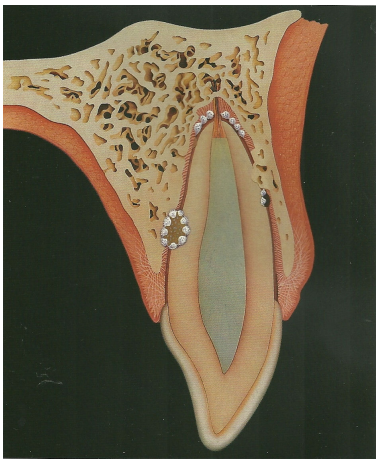

1.2 Ankylosis (replacement resorption) is rare except in intrusive luxation. Histologically represents a fusion of alveolar bone and root surface and can be recognized two weeks after replantation in cases of avulsion. The etiology in this case appears to be related to the absence of a vital periodontal ligament covering the root surface. It can be seen a direct connection between the bone and the root surface, being the root substance gradually replaced with bone. The disappearance of the periodontal space and the progressive root resorption are typical radiographic findings. It develops in two different directions, depending on the extent of the periodontal ligament damage covering the root: either a progressive replacement resorption, which gradually absorbed the entire root, or temporary replacement resorption, in which a set ankylosis disappears. Clinically, ankylosed tooth is immobile, high-pitched percussion.

1.3 Inflammatory resorption: histologically, bowls shaped areas of resorption both dentin and cement are seen with adjacent periodontal tissue inflammation. Inflammation and resorption activity are apparently related to the presence of infected necrotic pulp tissue in the pulp canal.
The pathogenesis of inflammatory resorption can be described as follows: minor injuries to the periodontal ligament and / or cement due to trauma or contamination with bacteria induce small cavities resorption on the root surface, possibly in the same way that in surface resorption. If these resorption cavities exposed dentinal tubules and the root canal contains necrotic and infected tissue, toxins of these areas penetrate the lateral periodontal tissues causing an inflammatory response. These, also will intensify the process of resorption which moves forward into the root canal.
Radiographically, is a typical finding root resorption with radiolucency in the adjacent bone.

2.1 Resorption of the root canal for replacement: an irregular broadening of the pulp chamber is radiographically detected. A variant has been called internal tunneling resorption. This is usually found in the coronal portion of root fractures, but it can also occur after dislocation. The characteristic feature is a process of resorption in tunnel along the root canal. Over time the resorption process stops and a total obliteration of the pulp canal takes place.
Histologically, the teeth show metaplasia of the normal pulp tissue to callosum bone. The continuum reconstruction of the bone at the expense of dentin is responsible for the gradual enlargement of the pulp chamber.

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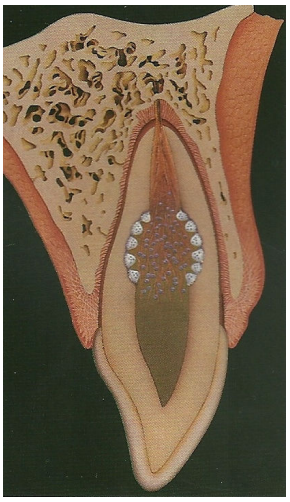


2.2 Inflammatory resorption of the channel is characterized radiographically by an oval shaped enlargement within the pulp chamber. Generally found in the cervical third of the canal. Histologically, there is a transformation of normal pulp tissue into granulation tissue with giant cells resorbing dentin walls of the root canal, advancing from the dentinal surface to the periphery. Necrotic pulp tissue or dentinal tubules infected with bacteria are, apparently responsible for maintaining the resorption process.

Treatment:

Protocol work:
Informed consent: The patient's father is informed on the nature and purposes of treatment, of the possibility of complications and possible alternatives to solve them. The adult accompanying the patient signed and stated agreement aforesaid.

Analgesia: the anterior maxilla was injected subperiosteally, deep in the groove at the height of the affected parts where anaesthetic liquids have good diffusion, because the vestibular bone plate is porous.

Complete isolation of the operative field: once placed the clams are rubber the whole area, the rubber, the clams are decontaminated with a cotton swab soaked in alcohol.

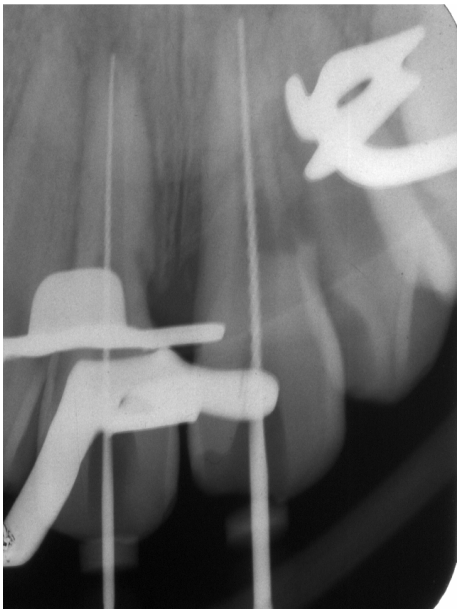
Cameral Opening: It is about getting a centred cavity, in a proper way and with the necessary compensatory wear that allow direct access to the root canal. To achieve this, the design must be based on the internal anatomy of the pulp chamber. In the case of the 11 and 21 teeth the opening cameral was made in the centre of the palatal surface with a round diamond at high speed, focusing in a perpendicular way on the palate face. A triangular shape with rounded ends, with base to incisal and vortices to gingival was attempted. Following this outline, both enamel and dentin was changed to a rounded tip conical stone and also the incidence of stone was changed: now placed parallel to the longitudinal axis of the tooth.

Neutralization of septic content: immediately after exposing the pulp chamber, it was placed in it a sterile cotton swab soaked in sodium hypochlorite 5% (potent tissue solvent and antiseptic) for 3 minutes to remove as much waste in this space before entering with another instrument in the interior of the root canal.

Cleaning stage:
Pulp removal: this maneuver was performed with a barber broaches which was taken inside of the ducts with a sawing move until some resistance was felt within it, then an inch was released for safety and 3 turns clockwise rotation was made. Finally it was pulled. Tissue in a state of decomposition that did not keep its cohesive stromal was removed; it looked rather white, ischemic.

Irrigation / aspiration: alternated irrigations with 10 volumes of hydrogen peroxide and sodium hypochlorite at 5% were used.

Record of the length of work: This record allows me to determine the apical limit of the surgical preparation. This limit coincides with the dentine cement inside the canal known as CDC limit.



In order to achieve this we used a combined procedure consisting of an apex locator and an orthoradial radiographic image to make a diagnosis that corroborate or rule out the possibility of communication between the duct and the lateral periodontium through external root resorption. In root perforation cases, the realising point of the duct to the periodontal ligament is a crucial measure.

The apex locator is an excellent aid for perforation diagnosis; it is considered a reliable instrument by Kaufman et al. who believe it is an essential factor for success in the location of lateral root perforations, however, still remains the importance of taking radiographs after locating the perforation to determine the location in relation to the bone crest. This instrument is used in the same way to locate an inch, only this time the tip of the file will be in contact with the artificial opening made by perforation.

A smooth file with a diameter and length according to the root canal observed on the preoperative radiograph was selected (11 tooth : smooth file n º 30, 25 mm long and 21 tooth: smooth file n º 45, 25 mm), to which a stop was set to a length fixed according to hook shaped electrode was placed in the corner of the lips and the other electrode which has the clamp was hooked on the file which was taken to the conduit, with the reader on it began to ascend the tube back and forth movements until LEDs indicated that we were 0.5 far from the apex. Throughout the route of the file in the interior of the duct the presence of a communication with the periodontium not detected. At that time the electrodes were removed and an orthoradial x-ray taken. After it was revealed it was established that the working length for:

→ Tooth 11 is 23 mm with reference to the incisal edge.
→ Tooth 21 is 23 mm with reference to the distal incisal edge.

During the conductometry using a pager was found that the resorption observed in the X-ray did not communicate the periodontium with the root canal. There was lesions (cavities) housed in the outer surface of both roots.

Forming stage:

Third apical preparation: the canal was carved at the apical level, giving a shape of retention and resistance to achieve that the canal final sealant material confine and to give a convenient form or a progressive cone form to the rest of it to facilitate the sealing. The preparation of this canal was done with great care in order to prevent the further weakened of the dentinal walls.

This was done with standard Ingle technique; it is an apical-coronal technique type and is applied in straight canals. It was started with the flat 15, 20 and 25 file of 25 mm, to 24 mm length; in this way the passenger file concept was achieved, which allows to cement canal so that the irrigant substance can arrive, cleaned and thus promote the medical paste dressing.

Then in the apical formation length, of 23 mm the 30, 35, 40, 45, 50, 55, 60 and 70 files were used in the 11 tooth and the 45, 50, 55, 60 and 70 in 21 tooth. These movements were driven by Roan balanced forces (impulsion toward the work length, three quarter clockwise turn, three quarters counterclockwise turn and traction). The 70 file was taken as memory file.

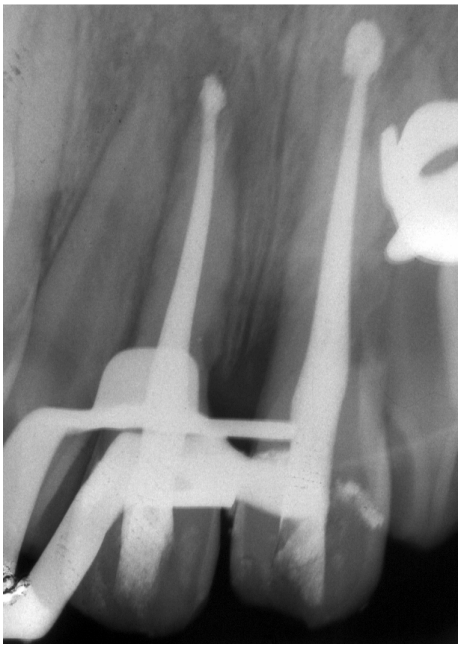
Lately 3 mm were dismissed from the working length, and with the 80, 90 and 100 file the perimeter filing was made which allows the lateral condensation technique.

It was always irrigated between file and file with rich series of hydrogen peroxide, sodium hypochlorite and hydrogen peroxide, returning to the 70 file to the work length as a recap. It was finally irrigated with 5 ml of distilled water and the canal was dried with sterile paper cones.

Dressing: (17/05/2010):

It was decided to do it in both pieces, with an alkali rapidly absorbable drug paste sealant. This consists of:

- Pure calcium hydroxide powder.
- Yodoform powder (equal parts).



Distilled water was added until a paste consistency to be carried into the duct was obtained.

This manoeuvre was performed with lentulo coils actionated with a micro motor and it was compacted with the memory file and plunger smaller instruments. Also with finer instruments a sobreobturation was attempted so that a paste part overextends the canal and occupies the periapical bone area in order to reactivate the process and promote its healing.

Since this is an impasto where its components do not react chemically with each other, its hardening is produces by dehydration and disappears of the tissues within 10 to 15 days, either by dilution with body fluids or by phagocytosis of giant cells process. It promotes apoptosis in osteoclasts and releases calcium ions required for mineralization process. This pasta is left for 10 days minimum.

Radiographic control: This image showed a good compaction of the alkaline impasto with the intentional canal sobreobturation to promote healing of periapical process. In the 21 tooth an impasto button in the apical region was formed. The impasto did not flow to the reabsorption distal area, which did not assure that there was no communication with the periodontium.

Temporary crown sealing: after removing all remains of alkaline impasto of inside the pulp chamber with swabs soaked in alcohol, a temporary seal with zinc phosphate cement was made, the clamp and the isolation damp were removed.

Final seal (07/06/2010):

After the analgesia, the temporary filling was removed with turbine and a round stone. The isolation of the operative field was performed with rubber dam and 1 premolar clamp in the 11 tooth.

It was irrigated with distilled water and with a mild work of 70 memory file residual alkaline remaining impasto was removed. The pasta debris was completely removed with gauze files soaked in alcohol. The canal was dried with sterile paper cones. And the final seal process was made.

The materials used were the following ones:

1. **Master Gutta-percha cones:** they must be of the same caliber as the memory file, for that reason the No. 70 cone was used in both pieces. The master cone was approved before being cemented with tactile and visual tests. And an x-ray was taken: conometry. Accessory cones: F and FM cones were used for lateral condensation technique.
2. **AH Plus Cement:** sealer agent based on an amine epoxy polymer; its composition include epoxy resin, calcium tungstenato, zirconium oxide, aerosil, iron oxide / amine Adamant, NN-dibenzyl-5oxanonano-diamine-1, 9, TDC-diamine and silicone oil. AH Plus ™ is a perfect improved version of the traditional DENTSPLY De Trey endodontic cement, the AH 26. It offers better biocompatibility, better radiopacity than AH 26, colour stability and it is easy to remove. Its handling is also easier and faster. It has excellent physical properties such as adequate fluidity with low shrinkage and solubility which ensures excellent sealing which is the goal of good conduct sealer. It comes in 2 tubes for hand mixing the two pastes or in AH Plus Jet mixing syringe for direct intraoral application.

   The accoutrement contains:

   - Paste A tube: A bis-phenol epoxy resin, F bisphenol epoxy resin, calcium tungstenato, zirconium oxide, silica and iron oxide.
   - Paste B tube: dibenzyl diamine, aminoadamantano, tricycle-decane-diamine, calcium tungstenato, zirconium oxide, silica and silicone oil.

It should be mixed equal volumes of 1:1 paste A and B in a glass slab or mixing pad using a metal spatula until achieving a homogeneous consistency. Ah plus Cement was spread in a mixing pad with a metal spatula, mixing both pasta evenly. The sealer cementum was taken to the conduct with lentulus coils, which is an instrument made of a spirally wound wire. The size of this is chosen based on the pipe diameter to be sealed. The micro motor was reverse operated so that the cement wet all the dentin walls and penetrated the canaliculi. Then cement was placed on the tip of the main cone and the canal was taken to the working length, a digital spacer was selected according with the canal space and it was introduced 3mm less than the long with swinging movements, in this way, because of the wedge effect the gutta-perchat, which is viscoelastic became deformed and created space for the accessory cones placement. When the spacer entered less than 3 mm it is considered that the canal is filled and a cherry-red heated ladmore instrument was used to cut the cones just at the entrance of the ducts and it was vertically condensed with a manual condenser. During lateral condensation the spacer was placed taking into account the major axis of the duct, therefore, if the major axis is vestibule-lingual, it will be lingual or vestibular condensed.

Temporary crown obturation: After cutting the cones the pulp chamber was cleaned with a sterile swab soaked in alcohol. It was dried with another sterile swab and the crowns were shuttered with zinc phosphate cement.

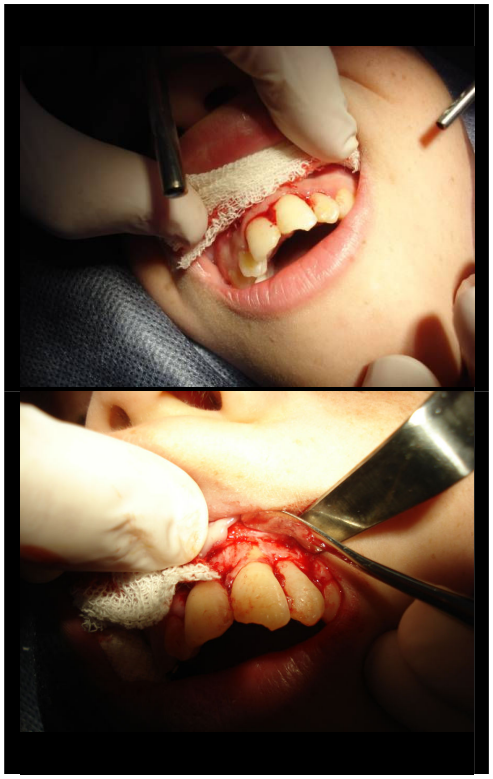
Absolute isolation removal: once the clamp and the rubber dam were removed the occlusion with its antagonist piece was controlled.

Final radiograph (07/06/2010): it could be observed a good tridimensional shutter and compact to the limit of conduct work. It was observed an over obturation of the sealant material. Crown reconstruction was acceptable.
Taking into account the clinical and radiographic evaluation with not encouraging prognosis data, it was decided to propose an alternative surgical resource with the application of hyaluronic acid to the responsible adult.
Once the proposal was accepted it was carried the **surgical stage** which also confirmed the resorption diagnosis; mainly to confirm or not the communication between the external resorption image and 21 tooth root canal.

Hyaluronic acid: is a polysaccharide, a linear polianonic hydrophilic of high molecular weight, composed exclusively of repeated disacárides units of glucuronic acid and N-acetylglucosamine. It is present in high concentrations in cartilage and in the synovial fluid. It is a major component of the body extracellular matrix; due of its viscoelastic properties it gives them moisturizes functions and joint lubrication. Furthermore, the presence of hyaluronic acid in the extracellular matrix allows nutrients transporting into cells and debris remove. It produce the type of prostaglandins which are the cause of inflammation to decrease and also stimulates tissue repair.

- It facilitates cell migration and proliferation.
- It maintains the matrix hydrated allowing the cell migration of the lesion.
- It enhances the formation of blood vessels.
- It stimulates fibroblasts and proteins proliferation: collagen and elastin.
- Cicatrization and regeneration of tissue and oral mucosa.
- It modulates the healing process.

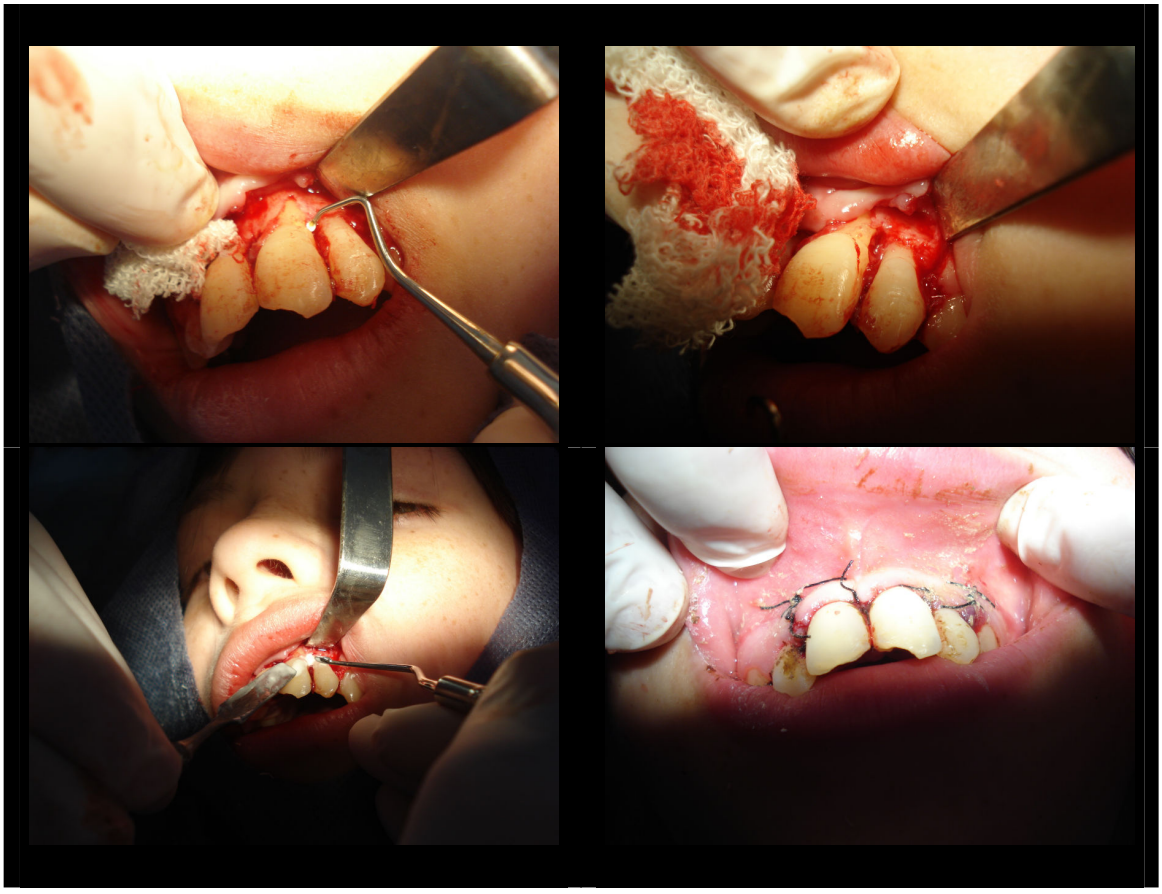
Surgical intervention:



Anesthesia was performed in the bottom of groove at the height of the teeth apexes (11 and 21) and also it was palatal placed to close the circuit. A carpule syringe was used where a short disposable needle was placed and 1.8 ml Indican anestube (2% lidocaine with epinephrine as a vasoconstrictor).

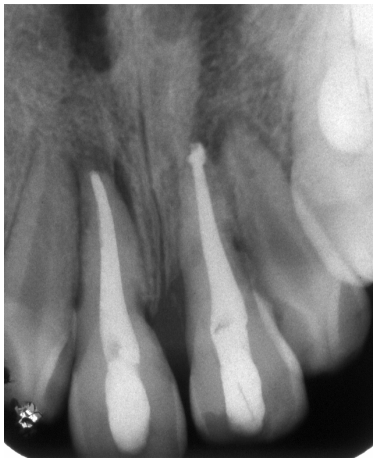
Neumann's vestibular flap incision and two compensating with scalpel blade number three and with a syndesmotome help was performed. The granulation tissue that was in both teeth roots was removed with black spoon and sharp excavators (11 and 21), housed in the crevices located in the cervical root surfaces.

These resorptions were found in DV face of the 21 tooth and in the MV face of 11tooth. It was washed with sterile physiological solution and hyaluronic acid was put in the affected area as stimulator of the signalling processes involved in the repair. The flap was repositioned and the tissues involved in surgery were sutured.



Immediate surgery RX control

It was still radiographically observed a periodontal widening mainly in the mesial apix of 11 tooth and in the 21 tooth periapical area it was also observed an overfilled sealant button smaller. The alveolar cortical was still discontinuous and the periapical cancellous bone with less radiopacity than the surrounding bone.



Surgery control after a month (02/08/2010):

It was radiographically observed apical resorption reduction and the beginning of the root apex remodeling of both pieces. The widening of the apical periodontal space was reduced but the widening, although a smaller one, in the mesial periodontal space of the 11 tooth. In the 21 tooth a smaller overfilled sealant button was noticed. It was observed a change in the periapical cancellous bone radiopacity.

1º clinical and radiographic control (25/10/2010):

It was decided to make the final reconstruction of both pieces with a composite type adhesive material both in the opening cavities as in the mesio-incisal angle of the 21 tooth. They did not show pain or fistula. There was still mobility.

The radiograph showed a remodeling of the 21 tooth overfilled sealant button A calcified tissue was seen between this and the root, suggesting an attempt of biological closure. In the 11 tooth an almost complete reduction of periodontal and apical enlargement was found.

2º clinical and radiographic control (22/12/2010):

It was clinically observed in good condition the definite coronary filling material. They were asymptomatic. .Both PD still with mobility but reduced.

In the radiographic control a separation gap between the apex and overfilled material in the 21tooth was seen, suggesting a root apex remodeling.

3º clinical and radiographic control (18/04/2011):

Clinically, the adhesive material was in good condition and the patient reported comfort because both pieces had no more mobility. There was no pain or fistula.

The periodontal space was normalized; the cancellous bone had normal aspect. The apices were in a remodelled process and the sealant button was getting away from the apex.

Bone remodelled was observed in the interdental marginal ridge.

4º clinical and radiographic control (13/06/2011):

El The patient did not report pain or mobility. The restorations were in good condition and there were not fistula.

In the X-ray an standard periodontium was observed, a cancellous with similar radiopacity to the rest of the bone one. The remodeling of apices, a size reduction and the removal of overfilled material was also observed

It could be assure the resorption end and also the deposition of a new tissue in both roots, which reduces the size of both lesions.

5º clinical and radiographic control (05/09/2011):

The patient had no clinical signs or mobility symptoms. The restorations were stable.

It was observed in the X-ray standard periodontal without widening. At an apical level a radiodensity homogenization between wall duct dentine wall, the periodontal ligament, the alveolar cortical and the cancellous surrounding bone and a tissue of a radiopacity similar to dentin, sealing the apical last millimetre that makes me think of a biological seal of the mineralized tissue, although its histological origin is not known.. The interdental bone crests have a standard margin at the cervical level of both teeth. The arrest of resorption and the deposition of new tissue in both roots, which reduces the size of both lesions, could be secured.

Discussion:

Piece 11 Avulsion: Post reimplantation cicatrization:

The event following the injury is bleeding from the ruptured vessel, once the bleeding was stopped there was forming of a blood clot situated towards the centre of the broken periodontal fibers (separation line between the two sides of the broken periodontal ligament), the platelets convert fibrinogen in fibrin, and have a high content of growth factors, which initiate the repair process. The repair process comprises the revascularization and formation of new tissue, coordinated by the movement of cells into the traumatized area, where macrophages form the healing front, followed by endothelial cells and fibroblasts. Macrophages regulate neovascularization, activated fibroblast proliferation; they can also be involved in nerve regeneration. Schwann cells increase the NGFR (receiver neurodevelopmental factor) expression; this seems to be important for the innervation of the replanted teeth.

In the 4 day starts pulp revascularization from the apical foramen, the damaged pulp tissue is gradually replaced by proliferating mesenchymal and capillaries cells, after nearly a week gingival collagen fibers are usually attached, There are few main fibers repaired in the infrabone area, it is observed circulation the cemental and alveolar faces of the ligament blood vessels.

Over a week the granulation tissue has replaced the clot. It forms a new junctional epithelium (the epithelium has reattached in the cement-enamel). This is important because it may involve less risk of gingival infection and / or lower risk of bacterial invasion of the root canal or periodontal ligament through the gingival crevice. In the connective tissue collagen gingival fibers also blend and periodontal fibers have regenerated, with small spaces between the alveolar bone and root surface around the cervical and apical regions. After two weeks the repair of the principal fibers has advanced so rapidly that about two thirds of the ligament mechanical strength has been recovered. The division line in the periodontal ligament is healed and collagen fibers are seen extending from the cement surface to the alveolar bone. Many nerve fibers ascend the periodontal ligament from the thick nerve bundle located around the apex, some nerve fibers run along blood vessels. Between the third and fourth weeks after replantation the vascular network was regenerated and the principal periodontal fibers are completely reestablished throughout the periodontal ligament. The extensively branched nerve fibers increase its thickness and density. Between the fourth and fifth week the process of pulp revascularization has generally concluded. Nerve fibers were observed in the apical and central portion of the pulp. The cicatrization process leads to the formation of a new layer of cells along the dentinal wall.

Pulp nerve density in regenerated pulps is related to the tissue's ability to form odontoblasts-like cells and to form dentin, suggesting that cell renewal is one of the environmental conditions that may influence the pattern and density of nerve regeneration in the replanted tooth.

Regeneration of the periodontal ligament including fiber architecture as well as vascular and neural elements was almost complete by 4 weeks after replantation. In two months the disposition of principal periodontal fibers appears normal in both direction and quantity. Regenerating and functioning nerve fibers can be find in the pulp. After two months the nerve density in coronary parts of the pulp is not much different than normal.
Revascularization is extremely beneficial and desirable, not only to keep the pulp space free of infection, but to allow the tooth to continue its development and consolidation, the frequency of revascularization in an immature tooth is 18 to 41%. The revascularization process in immature teeth should occur as follows: on the third day after replantation major injuries in the pulp can be seen, especially in the coronal pulp (necrosis, odontoblast layer disorganization). Following the tissue repair pattern, after 2 weeks the affected tissue in the coronal portion is gradually replaced by proliferative cells of the mesenchyme and by capillaries, leading to the formation of a layer of new cells along the dentinal wall, in the areas where odontoblasts had been destroyed.

A month later regenerated nerve fibers can be seen. Newly formed vessels appear throughout the pulp. If revascularization is not possible necrotic pulp infection will occur in 2 or 3 weeks.

Periodontal healing reactions:
There are 4 types:

- **Normal LPD healing:** Histologically there is total regeneration, which usually takes about 4 weeks to be complete including the nerve supply. This type of healing will only happen if the innermost cell layer along the root surface is vital. Radiographically, there is a normal LPD space without signs of root resorption. Clinically, the tooth is in its normal position with mobility and normal percussive tone.

  This will not happen in an avulsion because the trauma will result in minimal damage to the innermost layer of the LPD, favouring superficial resorption.

- **Superficial resorption healing:** (resorption related to restoration) histologically, this type of healing is characterized by localized areas along the root surface showing resorption lacunae repaired by new cementum. In contrast to other types of resorption, surface resorption is not progressive, it is self-limiting and shows repair. In cases of deeper resorption cavities the healing occurs but without restoration of original delineated of the root. Usually they are not rradiographically shown. Clinically, the root is in normal position and has a normal percussive tone.

- **Ankylosis healing:** (replacement repair) histologically, ankylosis represents a fusion of alveolar bone and root surface and can be demonstrated 2 weeks after replantation. It seems to be related to the absence of a vital LPD coverage above the root. The replacement resorption takes place in two different directions, depending on the degree of damage of the coverage of LPD root: either by progressive replacement resorption, which gradually absorbed the entire root, or temporary replacement resorption, in which established ankylosis disappears. The progressive replacement resorption is always started when the entire periodontal ligament is removed before replantation or after extensive tooth dissection before replantation. It is assumed that the injured LPD is repopulated with adjacent bone marrow cells, which have osteogenic potential and consequently will form ankylosis. The temporary replacement resorption is possibly related to adjacent areas of vital LPD. The ankylosed root becomes part of normal bone remodeling system and is gradually replaced by bone.

  Radiographically, ankylosis is characterized by disappearance of the normal periodontal space and the continued replacement of bone substance with bone. The replacement resorption can be recognized radiographically after 2 months of the reimplantation, however, in most cases could be from 6 months or one year. Clinically, ankylosed tooth is immobile and in children it is frequently in infraposition. The percussion tone is high, differing clearly from the adjacent teeth which are not hurt. The percussion test often reveals replacement resorption in the early stages before it can be radiographically diagnosed.

- **Inflammatory resorption healing:** (infection-related resorption) histologically inflammatory resorption is characterized by bowl-shaped resorption cavities associated with inflammatory changes in the adjacent periodontal tissue. The inflammatory reaction in the periodontium consists of granulation tissue with

numerous lymphocytes, plasma cells and polymorphonuclear leukocytes. Adjacent to these areas, the root surface is subjected to intense resorption with numerous Howship's lacunae and osteoclasts.

Inflammatory resorption pathogenesis can be described as follows. Minor injuries to the periodontal ligament and / or cement due to trauma or contamination with bacteria which induce small resorption cavities on the root surface, possibly of the same way that in surface resorption. If these resorption cavities exposed dentinal tubules and the root canal containing necrotic and infected tissue, toxins of these areas will penetrate the lateral periodontal tissues and cause an inflammatory response. Also, this will intensify the process of reabsorption which advances towards the root canal. The resorption process can progress very quickly, within a few months the tooth root can be absorbed.

Radiographically, inflammatory resorption is characterized by radiolucent bowl-shaped caviations with corresponding excaviations in the adjacent bone. The first radiographic sign of inflammatory resorption can be demonstrated as early as two weeks after replanting and is usually first recognized at the cervical third of the root. As in the case of ankylosis, this resorption type is usually evident within the first two years after reimplantation.

Clinically, the replanted tooth is loose and extruded. Moreover, the tooth is sensitive to percussion and the percussion tone is dull (compared with ankylosis).

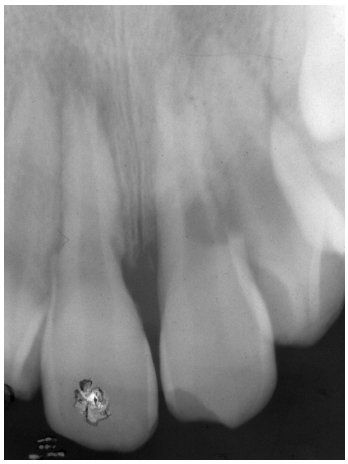
I believe that the treatment was a success because at the last clinical control the tooth was asymptomatic without mobility or fistula, ie healthy and perfectly functioning. Radiographically at the apical level could be seen af radiodensity homogenization between wall duct dentine, periodontal ligament, the alveolar cortical and the surrounding cancellous bone and a tissue of a radiopacity similar to dentin, sealing the last apical canal millimeter that makes me think of a biological seal of mineralized tissue, although its histology origin is not known.

Dental Piece 21 Intrusion:

The healing pattern is dominated by severe complications. Especially the frequent occurrence of pulp necrosis in teeth with immature root formation, external root resorption and loss of marginal bone are of concern, as these complications may lead to tooth loss.

Exposed to this trauma where there is a displacement of the dental element into the alveolus, a neurovascular pack collapse against the spongy periapical tissue occurs. This generates not only a lack of irrigation of the pulp but also, as product of the same anoxia, an aseptic death by hyaline degeneration, by massive cell ischemia. All generating crushing injuries bring about root resorption by release of enzyme products that act at the injured precementum level and finally into the dentin, leading to a irreparable tooth loss. In this case the resorption had already begun as it was observed on radiographs and surgical exploration confirmed the presence of a cavity in cervical of the root surface. With the pulp removal maneuvers done, a sealant with drug intermediate alkaline pasta, definite duct sealing and subsequent surgery with application of hyaluronic acid in the outer root injury, the root resorption was attempted to be stopped.

I say that the treatment was a success because at the last clinical control the patient was asymptomatic, the tooth without mobility or fistula, that is to say in health and functioning perfectly. Radiographically at the apical level a homogenization of radiodensity between wall duct dentine, periodontal ligament, the alveolar cortical and surrounding cancellous bone and a tissue of a radiopacity similar to dentin could be seen, sealing the last apical canal milimeter that makes me think in mineralized tissue biological sealant, although its histologic origin remains unknown.



Rx pre surgical (17/05/2010)

Rx definitive sealing (07/06/2010)

Rx last control (05/09/11)

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