

HISTOMETRIC STUDY OF PERIODONTAL TRAUMA IN DENTAL GERMS TO BE TRANSPLANTED - SCANNING ELECTRON MICROSCOPY

ESTUDO HISTOMÉTRICO SOBRE TRAUMA PERIODONTAL EM GERMES DENTAIS A SEREM TRANSPLANTADOS

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ABSTRACT

Dental transplants are of great interest in modern dentistry. Research has been directed toward the study of different techniques and observations of the results. Scientific basis is also to be observed and the aim of this paper is to associate technical with scientific data.

Dental germs in different stages of development were carefully removed from their alveolar cavities together with the dental sac. Trauma was observed in some areas resulting from the movements of extraction or of the removal of the dental sac by dissection. It should be noticed that the trauma produced by the removal of the dental sac is very uncommon, since the operation is performed at a mesoscopic level.

The material showed that the periodontal collagen net is complex in form and the meshes are wider in the surface. Smaller meshes could be seen closer to the cementum surface. Measures could be taken in order to have a basis of the distribution of collagen material around the dental root in different levels.

The results showed that extraction should be performed in a most conservative manner and the movements for extraction should be applied to the crown of the dental germ. The maintenance of the periodontal integrity is very important in order to preserve the vascular barrier created by the dental cementum.

UNITERMS:

Periodontal trauma; Dental germs, transplants.

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INTRODUCTION

Dental transplants are procedures in evidence for a long time and were recommended since many years ago. The first scientific principles for dental transplants were defended by FAUCHARD, BURDET and RICHTER within the years of 1.600 to 1.700, in Europe. Since then many reports of clinical and laboratory studies about transplants have been published (ANDREASEN, 1980; POGREL, 1987; DEBES, DRAGOO & SHIBATA, 1988; HERNANDEZ & CUESTAS-CARNERO, 1988 and MARZOLA, 1988).

Among different kinds of transplants, the autogenous or autotransplant, is the one which has the best results. It deals with a surgical transference of one tooth to a new dental socket in the same individual and can be recommended in several clinical situations: cases of loss, absence or retention of dental elements. The most common cases are the accidental loss of an incisor, the loss of a first molar and the retention of a canine (HERNANDEZ & CUESTAS-CARNERO, 1988; MARZOLA, 1988 and SCHULMAN, 1989).

To achieve the best results with the extraction technique some biological principles must be followed. Among these the maintenance of the periodontal membrane, that covers the root of the germ, is of primary importance because such structure will provide the specific cells to promote the healing of the corticallis, cementum and periodontal ligament.

The maintenance of the vitality of the ligament is strongly related to the handling of the tooth during transplantation. An atraumatic extraction, gentle handling and proper adaptation to the reception socket are basic requirements for the success of the technique.

The technique employed for extraction is responsible for the prognosis and must be as conservative and atraumatic as possible (COOLDGE, 1937; HAMMER, 1955; EMMERTSEN & ANDREASEN, 1966; ANDREASEN, 1970; CROPER & BERNICK, 1970; ANDREASEN, 1981; POGREL, 1987; ANDREASEN, KRISTERSON & ANDREASEN, 1988; ANNEROTH et al. 1988; DEBES, DRAGOO & SHIBATA, 1988; MARZOLA, 1988 and SCHLIEPHAKE & NEUKAM, 1990).

SCHLIEPHAKE & NEUKAM (1989 and 1990), developed a more conservative exodontic technique

when the third molar is retained. They created a method in order to evaluate the extension of damage caused to the periodontal structures due to dental extraction. They came to the conclusion that more conservative techniques minimize the trauma of the dental root.

Currently available SEM (author's previous observations) KOENINGS, BRILLIANT & FOREMAN (1974), NISHIMURA (1991) and MORABITO & DEFABIANIS (1992) shows that the periodontal region presents a very complicated three dimensional collagen fibers distribution. This collagen can be affected by trauma and installation of biological reactions as root ankylosis, and a root resorption, can occur (HENRY & WEINMANN, 1951; ATRIZADEH, KENNEDY & ZANDER, 1971; ANDREASEN, 1980; ANDREASEN, 1981; PAYNE, 1987; POGREL, 1987; MARZOLA, 1988; EDMUNDS & BECK, 1989; REMEIKIS & STRONER, 1989 and SCHLIEPHAKE & NEUKAM, 1990).

According to ANDREASEN (1980), POGREL (1987) and MARZOLA (1988), ankylosis after transplants is probably a response of the periodontal structures to the damage caused in some areas of the periodontal ligament during extraction. It could also be a final result due to the time elapsed from extraction till implantation, i. e. the time that the dental germ remained outside the alveolar cavity.

ANDREASEN, HJORTING-HANSEN & JOLST (1970) classified the root resorption (histologic and radiographically) in three different ones: 1) surface resorption that functions as a self limiting process of repair; 2) resorption by substitution in which the root tissue is replaced by bone; 3) inflammatory resorption, that is a loss of the root surface followed by a bone defect which involves the root.

Once the root resorption installed a root canal therapy with calcium hydroxide has been suggested as a proper way to control it. Several theories were developed to improve the pulp management, the root surface and retention of periodontal debris before transplantation. All these procedures should be toward the healing of a functional periodontal ligament and root surface with no resorption.

Another important factor for the success of a transplantation is the incomplete development of the

root with the root apex opened ideally between the half and 3/4 of the root length (LUSTMANN, 1978; JOHNSON & BURICH, 1979; NORDENRAM, 1987 and SCHENDEL et al. 1990). The complete root formation is subjected to more severe damages that way affect the periodontal membrane during extraction. The traumatic extraction together with the complete formation of the root apex contribute for a negative prognosis of the transplant: the newly formed vascular branch is not enough to irrigate the pulp through the apical foramina what causes te pulp death and subsequent inflammatory resorption or substitution resorption.

Not only the third molars are being used for transplantation but premolars and canines and these have the advantage they can be transplanted with the complete formation of the root apex because they are generally retained and thus protected by the dental sac (MARZOLA, 1988).

Care must be taken during operative procedures to prevent traumatic damage since this will be the major factor in the evaluation of the results and prognosis.

MATERIAL AND METHODS

Extractions of 30 retained third molars, 12 premolars and 05 canines were performed by a conservative technique which allowed the removal of the tooth as a whole (germ and follicle), preventing damage either to the periodontal ligament or to the membrane of the dental sac.

The regions in which trauma could not be avoided, were marked in the patient's file.

Voluntary patients who were aware of the research purpose, were selected from the Undergraduation Clinical Service - Bauru School of Dentistry. Prior to the surgery, the patients were submitted to routine clinical and semiological examinations in order to prevent future interference in the prognosis. The radiographic interpretation was performed by orthopantomographic and periapical radiographs. In some cases lateral and occlusal radiographs were performed to help tooth localization.

The patients were submitted to tooth extraction performed by the same operator and his team. Anesthesia was obtained by either regional or local

infiltration. After incision the muco periosteal flap was displaced and ostectomy was done before extraction. The teeth were kept in a saline solution and the dental socket was cleaned. After smoothening of the bone margins, the dental sockets were filled with blood and the suture of the flap performed. The file used was standardized for all the dental groups (File nº 1).

A third molar, two premolars and two canines were prepared for scanning electron microscopy. They were fixed in a 3,5% glutaraldehyde solution in phosphate buffer (pH 7,6 and temperature 4°C) for two hours and kept in the buffer solution for some days at low temperature. The teeth were rinsed again in phosphate buffer (pH 7,8) during 15 minutes. Pos-fixation was done in a buffer solution of 2% osmium tetroxide (OsO_4), at low temperature during two hours. After dehydration in a alcohol series, the material was sputtered with gold-palladium during 90 seconds. The material was observed in a Philips 401 SEM of the Institute of Anatomy of the Medical University of Lübeck/Germany (directed by Prof.Dr. Wolfgang Kühnel) and in a Stereoscan Cambridge model of the Pathologic Anatomy of the Faculty of Medicine of the University of São Paulo (directed by Prof.Dr. Antonio Sesso).

RESULTS

In the teeth selected for scanning electron microscopy the analysis was directed to study the possibility of dental transplant and reimplant. In the apices that were not completely formed, a pulp retraction (Figs. 1 and 2) or none (Fig. 3) could be noticed. The pulp connective tissue had an aspect of vesicle strings and were very dense in some areas and of vesicle plates in other regions. In roots with complete apices as in Fig. 4, it was observed that the periodontal tissue was very homogenous and some foramina could be detected besides the apical one.

It became very clear that at low magnification no periodontal lesions were apparent and the periodont had a regular and smooth surface. As magnification increase it could be distinguished that the periodontal tissue is composed by a collagen (Figs. 5 and 6) and elastic fibrous network. The collagen fibers formed regular meshes with diameters that varied from 5 to 0.1 micra and such dimensions were smaller in the deeper layers. The elastic fibers were distributed at random (Figs. 7 and 8). Some areas had an apparent reticular network.

Some ruptures of the fibrous network (Fig. 9) were evidente and in greater magnification the abnormal distribution of fibers and meshes were observed.

Stratification of different layers with different mesh sizes could be observed in many parts of the material. No differences could be noted in different types of teeth (Figs. 5 - 8).

Reimplantation was occurred with 50 teeth aproximatly and the postoperative follow up results was good. A follow up of 20 years showed that success is expected in 80% of the cases. Root resorptions were rare, wainly when treated by calcium hydroxide therapy.

DISCUSSION

In our SEM material we could observe that the teeth in which there was not a complete development of the root apex, the pulp tissue was retracted. This retraction may be due to the technique used for extraction of the tooth, in which, a great distention of the pulp tissue is induced. Retraction could also be due to the fixation technique but the same procedure was performed in all the cases and some of them showed no retraction at all. There is a way to preserve the integrity, at least the volumetric one of the pulp tissues. As MORABITO & DEFABIANI (1992) stated in their study about pulpal-periodontal connections in primary teeth, that apparently root canal has at apex level a branch stape. The opennings near the dental apex can be rounded or oval in shape and the canals showed no vessels. These canals are important in the study of the development of inflammatory process that can spreaded from pulp to periodontal ligament and apical tissues. The same can be discussed in permanent teeth. KOENIGS, BRILLIANT & FOREMAN (1974) collected 15 teeth and prepared them for SEM and also reported pulp diseases with periodontal involvement.

The periodontal tissue is presented as a network of collagen fibers with some elastic ones distributed at random. This collagen network is formed by meshes that become smaller as it goes closer to the root surface. This could prove that adherence of what is greater when the collagen tissue is injured close to the root surface. At greater magnification it could be detected that the collagen meshes were ruptured in some areas, what implicates some kind of trauma during extraction or removal of the membrane of the dental sac.

Observing the structure of the periodontal tissue at the scanning electrom microscope, one can conclude that the rearrangement as well as the reinsertion of the collagen network is almost impossible in the reimplantation or transplantation of a tooth.

The elastic fibers have the ability of providing some elasticity to the movements of the periodont. It would help to rearrange the collagen and reticular fibers when displaced. In the studied material no rupture of collagen meshes could be seen where elastic fibers were present. So it is possible to accept that the elastic fibers have an important function to preserve the spacial distribution of the collagen network.

The clinical follow up results showed that the if the trauma on the periodontal membrane can be minimized, a better postoperative can be expected.

The study should be continued in animals to obtain further information.

CONCLUSIONS

Based on the information obtained it can be concluded:

- ◆ Injuries on the membrane of the dental sac can promote root resorptions in respective areas.
- ◆ The extraction procedures should be the most conservative as possible.
- ◆ The strengths for extraction should be applied to the tooth crown shen the tooth is supposed to be transplanted.
- ◆ The perfect healing of the periodontium seems to be impossible to achieve in cases of tooth reimplant or transplant.

RESUMO

O transplante dental é manobra cirúrgica de grande importância na Odontologia. Pesquisas têm sido realizadas além do estudo de diferentes técnicas cirúrgicas com a observação dos resultados. Sua base científica é também observada, sendo que este trabalho vem colaborar em muito no esclarecimento dos dados associados à técnica cirúrgica.

Germes dentais em diferentes fases de seu desenvolvimento foram cuidadosamente removidos de seus alvéolos juntamente com a membrana saco dental.

O trauma foi observado em algumas áreas resultante dos movimentos da extração ou ainda da remoção da membrana saco dental pela dissecação. Na grande maioria das extrações de dentes retidos o trauma na membrana saco dental é muito freqüente, apesar da cirurgia ser realizada com muito cuidado.

Pelos resultados obtidos pode-se concluir que:

- ◆ A membrana saco dental quando traumatizada pode levar à reabsorções radiculares naqueles locais;
- ◆ As exodontias deverão ser o mais conservadoras possíveis;
- ◆ Os movimentos da mecânica da exodontia com finalidade de transplante, deverão ser todos executados na superfície da coroa dental;

- ◆ Pela complicação do aspecto ultra-estrutural do periodonto, parece ser impossível haver uma cicatrização perfeita deste, num caso de reimplante ou de transplante dental.

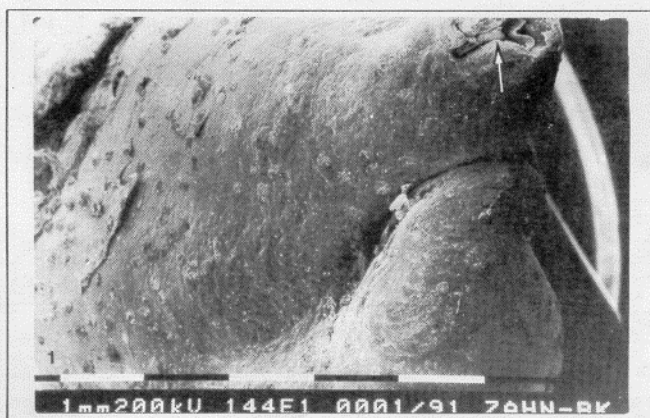


Fig. 1 - SEM of a root apex. Arrow shows a not completely formed apex. Original mag. 14x. Bar = 1mm

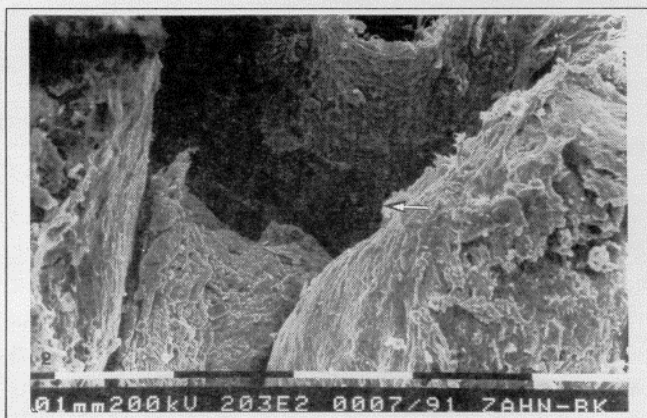


Fig.2 - Higher magnification of the Fig. 1 shows details of the apex. Note the pulp retraction (arrow). O.M. 203X Bar = 0.1 mm



Fig.3- SEM if a not completed root apex without pulp retraction. OM20.4x. Bar=1mm

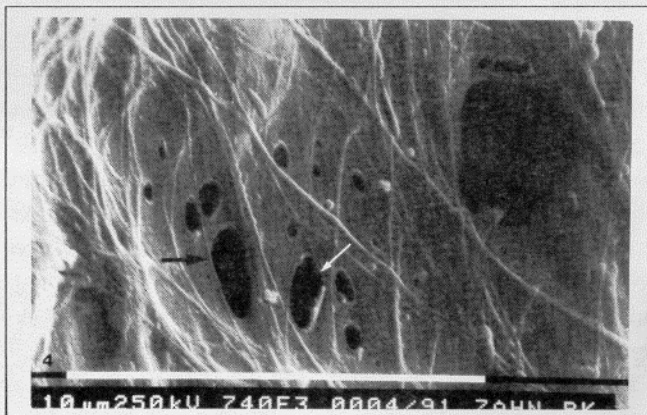


Fig.4- SEM of extra-foramina viewed in the root apex (arrow).O.M.116x. Bar=1mm.

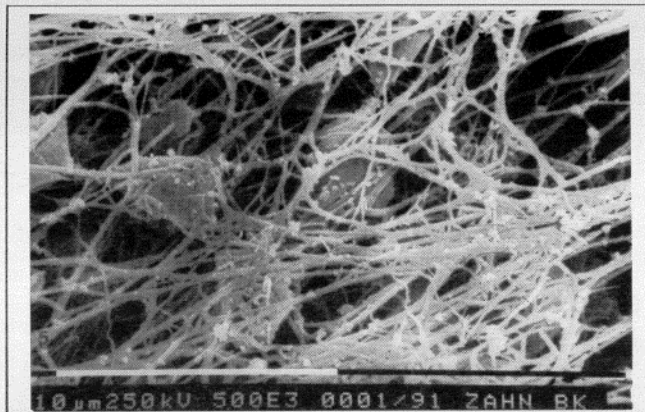


Fig. 5 - SEM of the periodontal collagen network. The meshes have different layers and different sizes. O.M. 5,000 x Bar = 10 μ m.

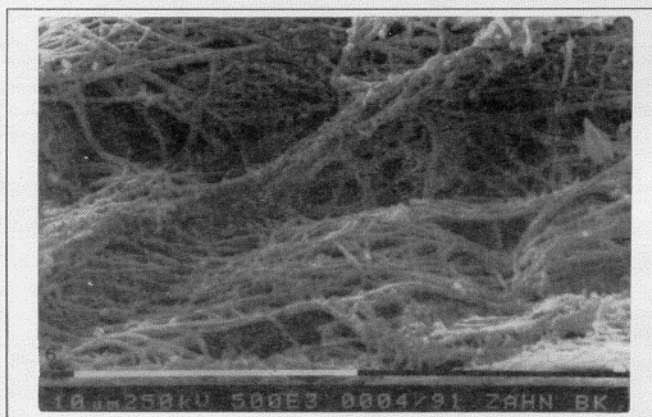


Fig. 6 - Collagen network. Note the rupture of some strings. Compare to Fig.9 O.M. 5,000x Bar = 10 μ m

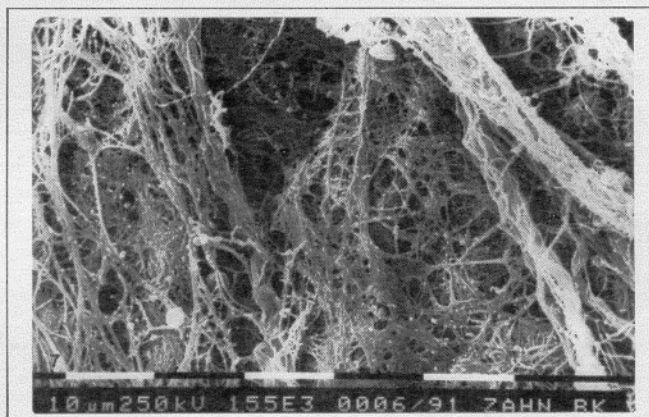


Fig.7 - SEM of the periodontal region with elastic fibers. Strings of wavy collagen fibrils bundles are to be distinguished. O.M. 1,550x Bar = 10 μ m.

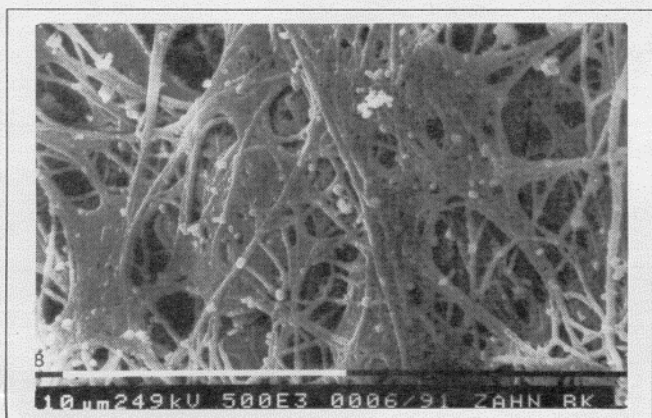


Fig. 8 - SEM of the periodontal region with elastic fibers. Observe different sizes of collagen meshes . O.M. 5,000x . Bar = 10 μ m.

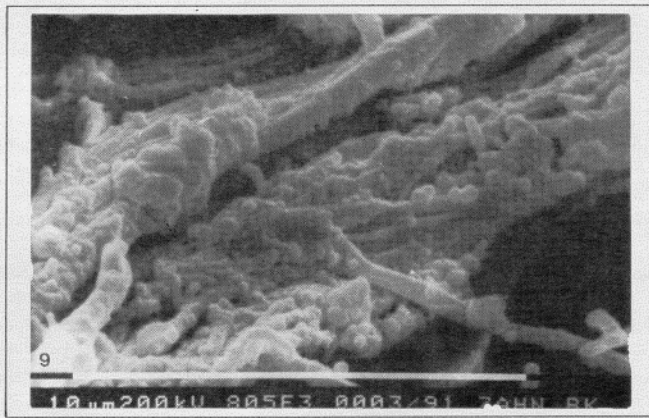


Fig. 9 - SEM of the ruptures collagen network with the formation of irregular strings and retraction nodules of the fibrils (arrows). Compare with the Fig. VI. In. Mag. = 8,050.

HISTOMETRIC STUDY OF PERIODONTAL TRAUMA IN DENTAL GERMS

TREATMENT FORM (#1)

Research: Histometric study of periodontal trauma in dental germs to be transplanted. SEM study.

NAME: _____

Age: _____ Sex: _____ Color: _____

Contact phone #: _____

Tooth group: () 3rd molars.

() Premolars

() Canines

Localization: () Mesial () A

() Distal () B

() Vertical () C

() Horizontal () I

() Inverted () II

() Facial () III

() Lingual () IV

() Pre-alveolar Place of trauma:

() Retro-alveolar

() Trans-alveolar Length of tooth:

() Vertical

Root morphology:

() fused () convergents

() divergents () distressed

Ryzogenesis: () completed () incompleted

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