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Dento-alveolar surgical treatment of dental disorders and bone defects

Theses of Ph.D. dissertation

Ph.D. School of Clinical Dentistry

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Full professor

Scientific consultant
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Full professor
2007
Summary

Disorders of the teeth and jaws may cause many problems in dental praxis. The aim of our work was to examine the therapeutic possibilities of anomalies in dentition (hypodontia, hyperodontia, retention) and disorders of the jaw. Clinical examination of bone regeneration stimulated by graft insertion was performed on experimental animals (Beagle dogs). The quantitative changes were evaluated by histological and histomorphometric methods.

2750 patients were included into the study with variable dentition anomalies in which impacted wisdom teeth and retention of the upper canine were the most frequent disorders. In 365 cases, cysts of the jaws were surgically treated. The most frequent surgery was the cystectomy, whereas marsupialisation and cystostomy were rare treatment. Small sized odontogenic tumors (predominantly odontomas) occurred in 33 cases. In 27 cases with odontomas, anomalies of tooth eruption were the most frequent complications. In edentulous patients elevation of the maxillary sinus base was performed in 31 cases by Cerasorb and BioOss graft insertion. In the majority of cases one stage technique was applied. However in several patients the bone replacement and implant insertations were performed in two steps. In the second step at the place of implantation there was a possibility to gain a bone cylinder for histological examination.

The effect of Cerasorb and combined Platelet Rich Plasma (PRP) + Cerasorb mixture was experimentally examined during the healing of extraction wounds in Beagle dogs. Histological and histomorphometrical results supported that in the early phase (6 weeks) the PRP promoted a quicker bone regeneration, however later the effect of the two types of treatments equalized.

Our results support that the dental surgeon plays a very important role in esthetic and functional reconstruction of the defects of the jaws.
Introduction

Classification of the treated jaw and dental disorders

Developmental disorders:
- Dental deficiencies (tooth bud aplasia)
- Hyperodonty

Unerrupted teeth
- Impaction, retention

Odontogenic cysts and tumors

Edentolous cases, bone atrophy, bone defect

Processes used to examine the treatment of dental disorders and bone defects

Clinical examinations

The method of sinus elevation was made to thicken the base of maxillary sinus. In case of less bone defects or moderate atrophy, a so called one-step method is applied: the graft and artificial root insertion can be done in one seat. In case of a significant tooth deficiency and advanced-stage atrophy a two step method must be used. The first step is the elevation of the maxillary sinus base with inserting bone substitute, and the root implantation is performed after a 6-8 months regeneration. There is a possibility at the implantation to gain a bone cylinder for histological examination, to analyse the density and the microstructure of the regenerating bone. By this the endurance of the bone bed can be stated, the local problems can be found and the long-term success of the implantation can be anticipated more safely.

There is a method to try and to compare the several bone implant types: the bilateral elevation of the sinus base. In this case the formation of the new bone is in the same person with similar histological and anatomical environment which is a great possibility to compare the effects of the grafts. There was an opportunity to perform animal experiments. We tried to find out what significant information can be gained with the pathological examination of the experimental and clinical materials in the aspect of dental reparation and bone replacement.

The purpose of our work was to compare the effect of two graft materials: the β-tricalcium-phosphate and the Bio-Oss bone-graft in bilateral maxillary sinus elevation.
Aims

1. Clinical research

1.1. Research of possibilities of surgical and orthodontical corrections of dental disorders in case of children and adolescents.
1.2. Research of possibilities of surgical reconstructions after jaw cystectomy and tumor-exstirpation.
1.3. Research of possibilities of rehabilitation of edentulous cases and jaw atrophy (bone replacement, implantation).
1.4. Histological research of osteointegration and resorption possibility of bone replacement materials (Cerasorb, BioOss) used predominantly in our institute.

2. Animal experiments

In the course of processing the graft stimulated bone regenerating materials gained from animal experiments the following aims were stated:

2.1. Comparison of histological effects of several bone replacement materials.
2.2. The regenerating bone’s density was compared by means of histomorphometric investigation of graft implantation.
2.3. The effects of complementary factors were investigated on osteograft stimulated bone regeneration.
2.4. The chronological succession of histological integration and resorption of grafts was investigated in animal experiments on the basis of multiple sampling.
Methods

Radiological methods:
- Orthopantomography
- Periapical imaging of teeth
- Postero-anterior x-ray imaging – with opened mouth
- Snap imaging

Dento-alveolar surgical methods
Treatment of developmental disorders
- Dental deficiencies (tooth bud aplasy)
- Hyperodonty
Treatment of teeth remained in breaking through
- Treatment of impactation, of odontogenic cysts and tumors
- Treatment of edentulous cases, bone atrophy, bone defect
- Bone replacement

Bone replacement
- Application of Cerasorb and BioOss
- Sinus elevation- one-and two-step techniques
- Bilateral sinus elevation – two step techniques

Animal Experiments
- Experimental animals
- Surgical methods
- Histological methods
- Histomorphometry
- Statistical methods
Results

Clinical results
Correction of developmental abnormalities

- Lack of permanent tooth germs: 41 cases. The lack of permanent tooth buds usually needs a complex treatment. The replacement can be done by means of artificial root implantation, tooth germ transplantation as well as by combining of dento-alveolar surgical and orthodontical methods.
The frequency of missing germ was studied in childish and adolescent population (ages of between 6 and 18).
- Hyperodonty: 39 cases. During the last ten years at our dento-alveolar surgery ambulancy altogether 68 hyperodontial permanent teeth were removed. Majority of them (79.4%) were situated in the upper dental arch with predominant majority in the frontal regions.
- Cleidocranial dysplasy: 4 cases

Dental eruption disorders

Treatment of unerupted wisdom teeth: 2316 cases.
- Lower wisdom teeth: 1795 cases
- Upper wisdom teeth: 521 cases
Treatment of retineated triads: 291 cases
- Surgical-orthodontical method: 234 cases
- Surgical reposition: 6 cases
- Removal: 51 cases

<table>
<thead>
<tr>
<th>Eruption disturbances lower wisdom teeth (1204 cases)</th>
<th>Number of cases</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Properly erupted</td>
<td>253</td>
<td>21%</td>
</tr>
<tr>
<td>Impacted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distoangular</td>
<td>216</td>
<td>18%</td>
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<tr>
<td>Vertical</td>
<td>98</td>
<td>8%</td>
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<tr>
<td>Mesoangular</td>
<td>469</td>
<td>39%</td>
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<tr>
<td>Transversal</td>
<td>24</td>
<td>2%</td>
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<tr>
<td>Horizontal</td>
<td>120</td>
<td>10%</td>
</tr>
<tr>
<td>Germectomy</td>
<td>24</td>
<td>2%</td>
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### Eruption disturbances upper wisdom teeth (1112 cases)

<table>
<thead>
<tr>
<th>Course</th>
<th>Number of cases</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Properly erupted</td>
<td>411</td>
<td>37%</td>
</tr>
<tr>
<td>Impacted Distoangular</td>
<td>156</td>
<td>14%</td>
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<tr>
<td>Impacted Vertical</td>
<td>289</td>
<td>26%</td>
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<tr>
<td>Impacted Mesioangular</td>
<td>222</td>
<td>20%</td>
</tr>
<tr>
<td>Impacted Transversal</td>
<td>11</td>
<td>1%</td>
</tr>
<tr>
<td>Germectomy</td>
<td>22</td>
<td>2%</td>
</tr>
</tbody>
</table>

### Removal of cysts, tumors and reconstruction of defects

Dento-alveolar surgical treatment of cysts
- Cystectomy: 287 cases
- Cystostomy: 6 cases
- Marsupialization: 72 cases

Surgical treatment of jaw bone tumors and dental eruption disturbances
- Odontoma: 33 cases
- Ameloblastoma: 5 cases

### Rehabilitation of edentulous cases and bone atrophy

Sinus elevation (31 cases)
- One-step techniques: 27 cases
- Two-step techniques: 4 cases
- Onlay-plastics (proetical rehabilitation): 2 cases
- Implants + bone replacement

### Results of animal experiments

During the experiments made on Beagle dogs samples were gained from the bones being regenerated in several occasions, so the graft embedding and bone regeneration were observed on the bases of histological and histomorphometric examination.

Moreover, the effect of Cerasorb itself and combined Platelet Rich Plasma (PRP) + Cerasorb mixture on the bone regeneration was studied.
### Table 1.

Percentage ratio of the area of the newly generated bone against the whole area. Average and SD values

<table>
<thead>
<tr>
<th>Time of sampling</th>
<th>Control side (Cerasorb)</th>
<th>Experimental side (Cerasorb + PRP)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bone Area %</td>
<td>Bone Area %</td>
</tr>
<tr>
<td>Week 6</td>
<td>30.8±18 .8</td>
<td>45.9±20 .6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P&lt;0.05</td>
</tr>
<tr>
<td>Week 12</td>
<td>49.4±17 .7</td>
<td>52.5±18 .4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>Week 24</td>
<td>61.9±16 .8</td>
<td>62.9±22 .4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NS</td>
</tr>
</tbody>
</table>

### Table 2.

Percentage ratio of the area of graft particles against the whole area. Average and SD values

<table>
<thead>
<tr>
<th>Time of sampling</th>
<th>Control side (Cerasorb)</th>
<th>Experimental side (Cerasorb + PRP)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Graft Area %</td>
<td>Graft Area %</td>
</tr>
<tr>
<td>Week 6</td>
<td>7.1±3.9</td>
<td>6.8±3.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>Week 12</td>
<td>6.9±4.1</td>
<td>6.3±3.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NS</td>
</tr>
<tr>
<td>Week 24</td>
<td>6.5±3.8</td>
<td>6.3±2.9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NS</td>
</tr>
</tbody>
</table>

### Table 3.

Percentage ratio of peri- and intragranular osteoid as well as bone generation showing granules. Average and SD values

<table>
<thead>
<tr>
<th>Time of sampling</th>
<th>Control side (Cerasorb graft)</th>
<th>Experimental side (Cerasorb + PRP)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Granule %</td>
<td>Granule %</td>
</tr>
<tr>
<td>Week 6</td>
<td>11.5±5.8</td>
<td>27.1±12 .6</td>
</tr>
<tr>
<td></td>
<td>P&lt;0.05</td>
<td></td>
</tr>
<tr>
<td>Week 12</td>
<td>36.5±18 .2</td>
<td>49.6±24 .2</td>
</tr>
<tr>
<td></td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Week 24</td>
<td>70.9±31 .4</td>
<td>75.9±41 .5</td>
</tr>
<tr>
<td></td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>
Along the border line of tissue-graft. Average and SD values.

<table>
<thead>
<tr>
<th>Time of sampling</th>
<th>Control side (Cerasorb graft)</th>
<th>Experimental side (Cerasorb + PRP)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bone generation %</td>
<td>Bone generation %</td>
</tr>
<tr>
<td>Week 6</td>
<td>15.4±8.2</td>
<td>31.2±23.0</td>
</tr>
<tr>
<td>Week 12</td>
<td>26.3±15.0</td>
<td>39.3±21.4</td>
</tr>
<tr>
<td>Week 24</td>
<td>58.4±24.7</td>
<td>61.2±37.7</td>
</tr>
</tbody>
</table>
Discussion

Discussion of clinical results

Regarding to our experience gained during our investigations related to hypodontia we can state that incidence of hypodontia is approx. eight times more frequently than that of hyperodontia. In making the diagnosis of aplasia the correct anamnesis, the clinical investigation and the appropriate x-ray are inevitable. Our data for the hyperodontia frequency (1.9%) equals to those of the international literature (1-3%). The practical importance of hyperodontia may not be disregarded. Along with the esthetical problems the following complications can be taken into consideration: The impaction or ectopy of the permanent teeth, congestion, eruptional and/or situational disorder of neighboring teeth, root resorption, follicular cyst, and fistulae. Because of all these factors their early realization, removal and orthodontical treatment of the caused disorders based on the expert opinion are necessary.

Cleidocranial dysplasia

In case of our patients, the craniofacial and skeletal symptoms characteristic to the CCD were present too, which made the diagnoses evident. In case of the CCD patients the treatment started in time is important because in the early ages the speed of growth of jaw bones and the structure of the bones are not significantly different from those of the average. The permanent teeth have no eruption inclination for the eruption because of the low activity of the osteoblast cells. This may make the outgoing of the treatment insecure. Further complication is that during the whole process of dental exchange the removable appliance is necessary, substitution of which can be expected more frequently than the average, because of the atypical eruption directions. By means of the co-operation of the representatives of several fields started in time and planned correctly in form of team work the successful treatment of the illness can be applied.

Impacted wisdom teeth

Taking into consideration the pathological malformations and the together with points of view of orthodontia, caused by the impacted wisdom teeth – almost surely occurring – the preventive removal of these teeth is reasonable. But from the point of view of operation techniques the impacted wisdom teeth have a certain development stage when their removal can be carried out very easily. If the root of the impacted wisdom tooth has not developed yet, having only its own cap, its removal is complicated because it is embedded in the bone deeply, this is why using a hoist is forbidden. Opening the bone crypt in this case is
accompanied with significant bone loss and in case of the lower teeth nervous lesion can occur. When the root has fully developed, in case of sharp, curved roots the removal is also difficult.

From the point of view of the operation techniques it would be the best if the root of the impacted wisdom tooth was developed up to its two thirds or three quarters part, and the root development is in course. The opened root edge in this case is chunky and roundish which makes the removal of the tooth easy together with the existing follicular cyst. This time using of hoist may be more successful and the tooth can be removed from the young plastic bone with minimal bone loss. The most advantageous age of development for the removal is between 14-18 years (with the root developed up to two thirds or three quarters) and it can be determined exactly with x-ray. It can be stated too, that the preventive removal of wisdom teeth being not able to erupt is reasonable taking into consideration the expected consequences and from the point of view of orthodontia by all means is advantageous.

**Retineated upper canines**

The experiences gained from the treatment call for the importance of the early realization of canines being in retention, and the importance of the detailed information of the concerned people and the necessity of the complex treatment.

**Odontogenous tumors**

The mixed, odontogenous tumors form in the age of the early stage of tooth development. They are benign jaw bone deformations occurring in the population of children and adolescents. The small tumors can be asymptomatic or they can cause eruptional anomalies. Among the first clinical symptoms we can find the lack of single teeth or groups of teeth, disordered position as well as the asymmetry of eruption. The characteristic symptom of the more advanced tumors is the assymetry of face and jaw bone. In case of any diagnosis accompanied with childish or adolescent dental development disorders or jaw bone deformity it is very important to make detailed radiological investigation. By means of early removal of slowly developing tumors the graver jaw bone deformities and the serious orthodontical problems can be prevented.

**Bone replacement**

On the basis of our results and of the data of literature we stated that Cerasorb and BioOss equally can stimulate the bone formation and the developing new bone has suitable
mechanical stability. The Cerasorb and BioOss graft has been well integrated in the bottom of the maxillary sinus and it gave a suitable support for the implanted artificial roots. The applied one-step techniques gave an excellent result in case of partial lacks of teeth when the implantation is used as the pillar of the bridges. In case of total lack of teeth or extreme thickening of the basal bone lamina of maxillary sinus the two step method should be chosen forsake of the better stability.

Animal experiments

Our studies aimed to make it clean how the PRP suspension can stimulate the bone regeneration effect of Cerasorb. The results of our preliminary experiments show that the PRP has stimulating impact in the early stage of recovery. Our histological results supported that the Cerasorb graft itself affected in an advantageous way the bone generation, which was focused first of all to the surface of grains and pores. This process was stimulated in its early stage by application of PRP.
Conclusions

Based on our studies it can be stated that the ambulant dento-alveolar surgery has an important role in the rehabilitation of dental disorders and defects disregarding the cause of these deformations. It is undisputable that these abnormalities are often multidisciplinary, and they need a long-term operation but de available results are more and more advantageous.

The different developmental disorders mean an especially difficult challenge to the dento-alveolar surgeon which concern not only the total row of teeth set but the jaw bones and the soft parts too. The tooth germ aplasy often requires artificial root implantation or germ transplantation but in moderate cases, the problem can be solved by an orthodontical treatment. The most frequent problem is the occurrence of impacted and retineated canines. The loss of these has serious effects because the lack of these has not only esthetic but functional importance. The canine leading plays a major role in the articular movements. The rarer hyperodontia occurs with itself or in connection with other bone or ectodermal disorders. Its therapy also requires the co-operation of a dento-alveolar surgeon and an orthodontist. The frequent wisdom tooth impaction often means a problem in the question of removal or retention. Several methods to the wisdom tooth removal have been developed, but complications always may occur.

A lot of reason can cause bone defects in the maxillofacial region. Graver bone deficiencies may form after traumatic lesions or removals of maxillary cysts and tumors and it makes the dental replacement impossible. The atrophy of the toothless jaw bone and the alveolar ridge is becoming a wide-spread problem which makes both the bone and implantative tooth replacement impossible. The appliance of bone substitute material is becoming an every-day method at our institute, and it makes the bone regeneration faster and facilitates reconstruction of the ability of chewing. The bio-activity, bio-integration and resorptive effect of the bone substitute materials were also observed in animal experiments.
New results

1. The early realization of the dento-alveolar surgery treatment of the factors hampering the tooth eruption (e.g. hyperodontia, odontoma) can promote the full value rehabilitation of the set of teeth.

2. The preventive removal of the wisdom teeth row retarded in the eruption is advisable in order to prevent the later complications (cysts, tumors, teeth jaw).

3. In animal experiments, the multiple sampling and the histological and histomorphometrical evaluation of the tissue fragments can be used in order to make decision about the integration of bone substitute materials.

4. Cerasorb is a bone substitute material with advantageous effects which can be proved by means of histomorphometrical investigations.

5. The bone forming effect of Cerasorb can be speeded up with platelet rich plasma in the early stages of recovery which can advantageously affect the graft stability.
Acknowledgements

I take this opportunity to express my thankfulness to Professor Dr. Suba Zsuzsanna, my consultant for the possibility to work out this topic being in the focus of my every day work as well as of my interest. Thank her for her support, valuable advises, opinions and critical remarks that I received from her during writing my thesis. Moreover, I thank her for her help in then collection of the bibliography. Without her, this thesis could not have been written.

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Moreover, I thank Dr. Takács Dániel for his help in the formation of my thesis.
Publications associated with theses in lectorated journals


IF: 0.2


IF: 1.043


IF: 1.772


IF: 0.935


IF:0.935


IF: 0.935

**IF: 0.935**


Publications associated with theses in NON-lectorated journals


Publications NOT associated with theses in lectorated journals


Publications NOT associated with theses in NON-lectorated journals


Books, book chapters


