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Faculty of Dental Medicine
University of Medicine - Sofia

PROBLEMS OF DENTAL MEDICINE

37 • 2011/ 1

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Sofia 2011
CONTENTS

SCIENTIFIC ARTICLES

IL-1B gene polymorphisms in conjunction with severity of chronic periodontitis
A. Mlachkova, Chr. Popova, M. Kicheva

Minimal invasive treatment of dental caries with children applying chemo-mechanical cavity excavation with Carisolv
M. Rashkova, M. Georgieva, V. Aleksieva

Questionare survey on oral hygiene awareness of children with hearing impairment
L. Doichinova, M. Peneva

Oral hygiene status of children with impaired hearing
L. Doichinova, M. Peneva

Application of photoinfrared photobiomodulation (λ-904 nm) after preprostetic preparation of patients for permanent fixed structure
L. Bayrakova

CASE REPORTS

Eosinophilic granuloma of the mandible - case report
E. Alexiev, Hr. Mihaylova, A. Bobeva

REVIEW

Pulp Tissue response to different bioactive materials used for direct pulp capping
R. Vasileva, D. Tsanova

Comparative review of the role and functions of intra-articular fibrous cartilage formations in joints and connections of the human body
M. Dimova
Severity of chronic periodontitis in conjunction with IL-1B gene polymorphism

A. Mlachkova¹, Chr. Popova², M. Kicheva³

Summary

Background: In recent years there has been some evidence of the influence of genetic factors on the pathogenesis and clinical features of periodontal disease. Studies on the influence of heredity on periodontal disease showed that in 38% to 82% of populations the presence of gingival inflammation, deep pockets and loss of attachment can be attributed to genetic factors. The literature suggests that IL-1B-single nucleotide gene polymorphism (different alleles of cytokine genes) influence the severity of periodontitis.

Aim: The aim in this study was to identify the IL-1B genotype in locus C [3953/4] T and locus T [-511] C in patients with moderate and severe chronic periodontitis in conjunction of the severity of periodontitis.

Material and methods: All the patients with moderate and severe periodontitis were tested for IL-1B gene polymorphism (single nucleotide polymorphism (SNP) in material from gingival tissues by PCR method. About 5mg of each DNA sample were used for both SNP IL-1B C [3953/4] T (rs1143634) and IL-1B T [-511] C (rs16944) genotyping by real-time PCR assay (Mastercycler ep realplex, Eppendorf AG), using QIAamp DNA Micro Kit (Qiagen).

Results: The results of this study show statistically significant correlation between IL-1B C [3953/4] T polymorphism and severity of chronic periodontitis. It’s established a moderate risk of severe chronic periodontitis in the presence of IL-1B T [-511] C polymorphism (rs_16944) – homozygotes for allele C.

Conclusion: The presence of gene polymorphisms of IL-1B (C [3953 / 4] T) can be determined susceptibility to periodontitis and affects the severity of periodontal disease. Future research on the prevalence and genetic variations of many loci simultaneously may elucidate the involvement of genetic factors in the initiation and progression of periodontal disease.

Key words: chronic periodontitis, severity of chronic periodontitis, IL-1B gene polymorphisms, single nucleotide polymorphism.

Introduction

Periodontal diseases are initiated by a limited number of specific microorganisms - predominantly Gram-negative anaerobes, which have the ability to activate local and systemic response as cascades of inflammatory and immunological processes such as destructive effects in the connective tissue attachment and the alveolar bone (12). The clinical and morphological manifestations of periodontitis are inflammation in the gingiva, loss of attachment with periodontal pocket formation and loss of alveolar bone, which, however, show variations in identical levels of plaque and periodontopathogenic microorganisms. Considerable findings in the pathogenesis of chronic periodontitis are shaping today’s understanding that periodontitis is disease, caused by many different factors, whose initiation, progression and severity are influenced significantly by genetic factors and environmental components (6,24).

Today it is assumed that there are two basic and linked components that constitute the etiology of the chronic periodontitis and de-
termine the clinical manifestation – the periodontopathogenic bacteria above and below the marginal gingiva and the host mediated destructive response to specific causal bacteria and their metabolites. There is evidence that certain genetic variations (genetic polymorphisms) affect host response through the expression of receptors and the secretion of pro-inflammatory cytokines (13,17). The genetic factors are probably important determinants of the risk of periodontal disease, assuming that these diseases are polygenic rather than monogenic (5).

There have been some genetic polymorphisms in the genes of the IL-1 group that show relation to periodontitis. In controlled studies greater severity of periodontal diseases was established with conjunction with genes variations (10,20,21,24,25,26,33).

There are three known IL-1 genes in a cluster of human hromosome 2q13 (45). Two of them encode proinflammatory proteins (IL-1α and IL-1β), producing IL-1α и IL-1β, while the third gene (IL-1RN) encodes a related protein that binds IL-1 receptors but acts as a receptor antagonist (IL-1ra) and not activate intracellular signaling (4,8,15,16).

Data from some studies suggest that different alleles of the cytokine genes may determine diverse susceptibility to the disease and may influence the development of periodontal disease, and can also modify the clinical expression (9,17,18,32).

Large number of single nucleotide polymorphisms (SNPs) have been studied in connection to the secretion of cytokines and receptors (30,34,38). Based on his 1997 study results on polymorphisms in genes that code IL-1A (IL-1α), IL-1B (IL-1b) and IL-1RN (IL-1ra), Kornman et al. suggest that genotypes that include carriers of a rare allele 2 (∗ 2) in the IL-1A-889 and IL-1B+3954 may serve as genetic markers of the disease severity in patients with chronic periodontitis (22).

In several studies, allele 2 of IL-1B (+3954; -511), alone or in combination with IL-1A (+4945, -889), is associated with patients with severe periodontitis (2,3,9,18,19,27,28). An interesting fact is that the genetic reliance of periodontitis is proved only when the group of patients surveyed was smokers excluded. Such standardization of the studied patients can identify the importance of individual risk factors (11,14,23).

It has been suggested that the simultaneous carrying of alleles IL-1A∗2, IL-1B∗2 and IL-1RN∗2 may determine the individual predisposition towards the development of periodontal disease even without the presence of large amounts of specific periodontopathogens by the overproduction of IL-1B protein and the insufficient production of IL-1ra protein in the immune response and / or inflammatory stimuli (29,35,36,37). Therefore, genetic tests can be able to determine the representation of a genetic polymorphism whose presence is associated with the susceptibility to periodontal disease (1,7). The detection of gene polymorphism might be important for the prediction of the disease development in the presence of local etiologic factors and can give a response to the variations in the severity of the clinical parameters of the chronic periodontitis.

The aim of the current study is to identify the IL-1B genotype in patients with moderate and severe chronic periodontitis in order to establish a relation between the presence of IL-1B polymorphisms and the disease severity.

Materials and methods:

1. The selection of patients was made based on clinical and radiographic diagnostic criteria. The study included patients with moderate (loss of attachment from 2 to 4 mm) and severe periodontitis (loss of attachment 4 to 6 mm, depth of pockets 4-6mm, alveolar bone loss from 4 to 7 mm measured on conventional radiographs, without periodontal therapy con-
ducted in the last 6 months, without systemic diseases and medication in the last 6 months, with a minimum of 20 teeth.

2. For the clinical evaluation of the periodontal status of patients the following clinical parameters were measured: Hygiene index - HI, Papillary bleeding index - PBI, drilling pocket depth in mm (Pocket depth - PD), loss of clinical attachment in mm (Clinical attachment level - CAL), width of attached gingiva in mm (Attached gingival width-AGW), gingival recession in mm (Gingival recession - GR), furcation lesions by horizontal drilling (Furcation involvement - F) according to the Hamp classification of 1975 and qualification of the teeth mobility by the scale from 1 to 3.

3. A study of IL-1B gene polymorphisms in gingival tissue from patients with moderate and severe chronic periodontitis was carried by TaqMan SNP genotyping. The method is applicable for known point mutations and allows distinguishing by single base change. A set of specific primers and probes is used for determination of each SNP.

The gingival tissue was sampled via excision after a local anesthesia to obtain a 3mm3 sample which was stored in 1.5ml sterile tubes at -80°C. QIAamp DNA Micro Kit (Qiagen) was used for genomic DNA (gDNA) extraction. Approximately 5-10 mg of each tissue sample was used for gDNA extraction. Two SNPs were identified: IL-1B C[3953/4]T (rs1143634) and IL-1B T[-511]C (rs16944) via TaqMan real-time PCR on Mastercycler ep realplex instrument (Eppendorf AG).

DNA extraction procedure includes overnight sample lysis in 400 μl ATL buffer and 20 μl Proteinase K at 56°C and 900rpm shaking. After that 200μl AL buffer are added to the lysate and vortex for 15 sec. Sample lysate was incubated for 10 min. at 70°C and 900rpm shaking. 200 μl ethanol (96-100%) is added to the sample, vortexed for 15 sec, and the whole lysate was transferred to the QIAamp MinElute Column. The columns were centrifuged at 6000×g (8000 rpm) for 1 min. The column is transferred to a sterile tube and the old tube is discarded along with the liquid that has passed through it. The remaining tissue was transferred to a QIAshredderSpin column and centrifuged at 20,000xg (14,000 rpm) for 2 min. The liquid that has passed was transferred over the already used QIAmp MinElute Column and centrifuged at 6000×g (8000 rpm) for 1 min. The column was placed onto a new collection tube. 500 μl AW1 (washing) buffer were added to the QIAmp MinElute Column and centrifuged at 6000×g (8000 rpm) for 1 min. The column was transferred to a new sterile tube and the old tube was discarded along with the liquid that had passed through it. 500 μl AW2 (washing) buffer was added to the QIAmp MinElute Column and centrifuged at 6000×g (8000 rpm) for 1 min., after which the column was transferred to a new sterile tube. The column was then transferred in a new 1.5 ml tube and DNA eluted in 30μl AE buffer after 5 min. incubation at room temperature and centrifugation at 20,000xg (14,000 rpm) for 1 min. in order to dry the membrane. The column was then transferred to a new sterile tube. The column was centrifuged at 20,000xg (14,000 rpm) for 3 min, in order to dry the membrane. The purity of DNA was determined by both A260/280 and A260/A230 ratios.

DNA quantity and concentration was determined via measurement at 260 nm against elution buffer. The purity of DNA was determined by both A260/280 and A260/A230 ratios.

TaqMan SNP assays were run according to the manufacturer instructions (AB, Life Technologies, USA) on Mastercycler ep realplex (Eppendorf AG) and data analyzed by the instrument software. The results are presented in graphical form (Fig. 1).

**Statistical Methods**

The data was entered and processed with statistical package **IBM SPSS Statistics 19.0.** The level of significance for rejecting the null
Fig. 1. TaqMan SNP assays according to the manufacturer instructions and data were analyzed by the instrument software.
hypothesis was chosen as \( p < 0.05 \).

The following methods were applied:

1. **Descriptive analysis** - the frequency distribution of the signs at issue is presented in tabular form, broken down by groups of study.
2. **Variance analysis** - calculating the estimates of central tendency and dispersion.
3. \( \chi^2 \) Test and Fisher exact test - to check the hypothesis of a link between categorical variables.
4. Nonparametric Shapiro-Wilk test - to check the type of distribution.
5. Nonparametric Mann-Whitney test - for hypothesis testing for the difference between two independent samples.

**Results and discussion**

Thirty subjects with chronic periodontitis were enrolled in this study, depending on the severity of chronic periodontitis, which was measured by the parameter loss of clinical attachment (Clinical attachment level - CAL) in both groups are presented in Table 1. The table shows that there are no statistical differences in the distribution of severe and moderate periodontitis in the control group (62.52% severe and moderate 37.98%) and the experimental group (56.99% and 42.82% respectively), which is considered as a normal standardization of both groups, needed for evaluation of the studied parameters.

Table 2 presents the reliance of the severity of periodontitis by IL-1B genotype in locus T[-511]C. There is equal distribution of heterozygote and homozygote genotypes among the patients with moderate periodontitis. In

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Control group</th>
<th>Test group</th>
<th>( p )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n )</td>
<td>( \bar{x} )</td>
<td>SD</td>
</tr>
<tr>
<td>CAL 1-2 mm</td>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CAL 3-4 mm</td>
<td>10</td>
<td>37.98</td>
<td>6.83</td>
</tr>
<tr>
<td>CAL &gt; 5 mm</td>
<td>10</td>
<td>62.52</td>
<td>6.43</td>
</tr>
</tbody>
</table>

*Table 1. Distribution of studied patients according severity of periodontitis*

<table>
<thead>
<tr>
<th>Genotype type</th>
<th>Statistics</th>
<th>Severity of periodontitis</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Moderate</td>
<td>Severe</td>
</tr>
<tr>
<td>Homozygote</td>
<td>Number</td>
<td>4</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>50.0</td>
<td>54.5</td>
</tr>
<tr>
<td>Heterozygote</td>
<td>Number</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>50.0</td>
<td>45.5</td>
</tr>
<tr>
<td>Total</td>
<td>Number</td>
<td>8</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

*Table 2. Analysis of correlation of genotype rs_16944 IL-1B T[-511]C to severity of periodontitis (\( p > 0.05 \))
patients with severe periodontitis the homozygote genotypes prevail (54.50% homozygote vs. 45.50% heterozygote without statistically significant difference).

The data presented in Table 2 indicate that there is no significant correlation between IL-1B T[-511]C genotype and the severity of periodontitis (p>0.05). The obtained results in this study don’t clearly indicate that homozygote genotype with respect to IL-1B T[-511]C is associated with greater severity of chronic periodontitis. The results of a meta-analysis in the literature (31) have shown that only two of the analyzed studies have found increased risk of chronic periodontitis associated with IL-1B T[-511]C polymorphism, namely T allele (OR: 1.987). The meta-analysis also showed that patients with heterozygote and CC genotypes are at moderate risk of developing chronic periodontitis (OR: 1.438). Actually, the results obtained in this study showed similar results, namely that the risk of development of severe chronic periodontitis is moderate for patients with CC genotype in IL-1B T[-511]C locus.

For the other studied IL-1B polymorphism - C[3953/4]T, our results presented in Table 3, showed a statistically significant association of the CC genotype with both severe (72.7%) and moderate (25.0%) periodontitis (p<0.05). As far as the heterozygous genotypes are concerned, there is a statistically significant higher rate of moderate periodontitis (75.0%) and significantly lower rates of severe periodontitis (27.3%) (p<0.05).

These data suggests that CC genotype of IL-1B C[3953/4]T is associated with the greater severity of chronic periodontitis. The obtained results are similar to the findings in most of the published studies (meta-analysis performed on 53 articles), showing that T allele carriers are associated with 45% relatively increased risk of chronic periodontitis in Caucasians (OR: 1.447) and twice increased risk of periodontitis for the Asian population (49). The meta-analysis provides evidence of an association between the polymorphism of IL-1B C[3953/4]T and the chronic periodontitis. Our data also support the relation between IL-1B C[3953/4]T polymorphism and the severity of chronic periodontitis.

**Therefore:**

1. A statistically significant correlation between IL-1B C[3953/4]T polymorphism and the severity of chronic periodontitis was established.

2. A moderate risk of development of severe chronic periodontitis in patients with CC genotype of IL-1B T[-511]C was established.
**Conclusion:**

reported data supplement the current understanding of the periodontitis pathogenesis and serve for identifying the risk of severe chronic periodontitis development. These results could influence both prophylactic and therapeutic strategies. Genetic tests for determination of IL-1B polymorphisms may be a useful tool in the clinical practice for patient susceptibility assessment to periodontitis and for better understanding the individual causes of the disease severity.

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**References**


16. Hurme M. & S. Santtila. IL-1 receptor antagonist (IL-1RA) plasma level is coordinately regulated by both IL-1 RA and IL- 1β genes. European Journal of Immunology, 1998; 28: 2598-2602.


20. Kobayashi T., C. Westerdaal, A. Miyazaki, T.


34. Santtila S., K. Savinainen & M. Hurme. Presence of the IL-1 RN allele 2 (IL-1RN*2) is associated with enhanced IL-1β production in vitro. Scandinavian Journal of Immunology, 1998; 47:195-198.


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Minimal invasive treatment of dental caries of children, using chemo-mechanical excavation with Carisolv

M. Rashkova, M. Georgieva, V. Alexieva

Summary

Introduction: Treatment of dental caries with minimal intervention requires a removal of bacterial infection and only full demineralized dentine. Through the last years are created various atraumatic methods of controlled excavation of infected dentin, as chemo-mechanical cavity preparation with Carisolv is one of them.

Aim is a research of a controlled chemo-mechanical excavation with Carisolv at treating caries with minimal interventions of children.

Material and methods: 22 children were treated and documented at the age between 4 - 9 years old and 38 carious lesions were prepared, 8 on permanent and 30 on primary molars (16 proximal and 22 occlusal caries). Patented excavators were used for carious dentine removal with Carisolv. Cavity pulp basis were treated until full infected dentine is removed and affected dentine was left (dentin with partial demineralization and reverse collagen destruction). Cavities were filled with GIC – Triage GC, composites, in some cases calcium hydroxide was used. Teeth were followed for 6 month through evaluation scale.

Results: Microinvasive treatment of dental caries, using chemo – mechanical excavation with Carisolv is very appropriate for negative and strongly negative children. A protocol for application of this method was made. During the period of six months there was not registrated any neither subjective symptoms nor objective date for occurred complications of the treated clinical cases.

Conclusion: Controlled chemo – mechanical excavation is a felicitous micro-invasive method of approach to the infected dentin of the caries treatment in childhood.

Key words: controlled excavation of the carious dentin, infected dentine, affected dentin, chemo – mechanical excavation, Carisolv

Introduction

Minimal invasive approach is modern philosophy in dental medicine. The aim is to prevent and expose disorder in its early stage in order to avoid invasive operative treatment (13, 17, 19, 20). Minimal invasive treatment is based on four significant modern concepts - early diagnostics, moulding of oral environment on the base of assessment of caries development risk, microinvasive cavity preparation, dynamic treatment and utilizing of biologically active obturating materials and modern adhesive systems (19, 20). Treatment of dental caries with minimal intervention imposes new rules for cavity preparation. One of them is removal of bacterial infection and of only irreversible affected tooth structures. Various techniques for microinvasive cavity preparation have been imposed as true alternative to conventional methods for the last few years (9, 15, 16). Altering the essence of cavity preparation, “atraumatic restorative treatment” (ART) established to be applied in developing countries, turns into one of the most modern MI methods while working with children. Compounding of
ART - technique and Carisolv chemical impact establishes chemo-mechanical method for controlled cavity excavation (1, 3, 4, 7, 8, 12, 14, 18).

Other similar methods are chemo-mechanical excavation with pepsin gel (SFC-VIII, 3M ESPE, Seefeld, Germany), caries excavation with sono-abrasion, “FACE” (Fluorescence-aided) caries excavation, excavation controlled by laser fluorescence, laser excavation, etc. The aim of all these methods is controlled removal of infected dentin and conservation of affected, which could be remineralized due to its preserved collagen structures and enough mineralization (11, 12, 16, 10).

In child dental medicine chemo-mechanical method for controlled cavity excavation with Carisolv has its own advantages and definite indications for application, which have not been studied with children so far.

The aim of present study is to nominate indications for microinvasive caries treatment application by means of controlled chemo-mechanical excavation with Carisolv with children and to make a medical report.

1-st task: Assessment of the children’s response to controlled chemo-mechanical excavation with Carisolv;

2-nd task: Depiction of caries lesions, prepared by means of controlled chemo-mechanical excavation with Carisolv;

3-rd task: Making a report for controlled chemo-mechanical excavation with Carisolv;

4-th task: Follow-up observation of the outcomes 6 months after the treatment.

Materials and methods

22 children, aged between 3 - 9 years (13 girls and 9 boys), have been treated. Before treatment the children’s behaviour have been assessed in a dental office according to Frankl scale (6):

Code 1 (strongly positive) - the child accepts the treatment, has a good contact with the dentist and does not fear;

Code 2 (poorly positive) - the child has cautious behaviour, questions a lot, responds to the dentist;

Code 3 (poorly negative) - the child is reserved, not responsive but reluctantly collaborates;

Code 4 (strongly negative) - the child does not allow to be treated, cries, shows strong hostile attitude.

The children’s response to the certain manipulation was examined interviewing them for short after the manipulation. The replies are generalized into 4 groups: (1) strongly positive; (2) the child prefers drill to excavator; (3) the child responds positively but gets bored due to the duration of manipulation with Carisolv; (4) the child cannot give a definite answer.

The children’s tooth status has been fully examined and recorded, the risk of developing caries has been assessed and an individual prophylactic programme has been made.

Sticking to the report for cavity excavation and Carisolv, 38 temporary and permanent first molars’ caries were treated. We applied microinvasive approach to the carious dentin utilizing the selective chemical impact of Carisolv on the infected dentin and its sparing impact on the af-

Figure №1 Distribution of treated children according to age factor
fected. Additionally the process was controlled by staining.

The duration of each cavity preparation was timed with chronometer. The obturation of cavities was performed with biologically active obturating material (GYTs - Triage GC), but with the deepest lesions calcium-hydroxide liner was added. Concerning to the first permanent molars’ lesions laminar technique with photo-composite was utilized. The teeth undergone obturation were observed for postoperative sensitivity and complications within 6-month period: every 1-st and 5-th day and every 1-st, 3-rd and 6-th month.

Subjective indexes | Objective indexes
--- | ---
Pain while chewing | Obturation faults
Pain caused by warm and cold | Caries referred to the obturation
Spontaneous pain | Deposit of dentin over the pulp (Ro gr)

| Table №1 Scale for assessing the latest effect of caries treatment applying chemo-mechanical excavation with Carisolv |

A question form was established for marking the certain steps while applying the methods of chemo-mechanical excavation with Carisolv, which was filled in for each particular cavity by both child experts, performing the task. A report concerning the method application was made based on the obtained outcomes.

Results

1. Assessment of the children’s behaviour in a dental office and their response to the cavity excavation with Carisolv. In order to examine the children’s response to the manipulation of excavation with Carisolv, first we grouped them according to the type of behaviour towards dental treatment on the base of Frankl scale (Figure №2).

![Figure №2](image)

*Figure №2 Differentiation of the children according to their behaviour during treatment and based on Frankl scale*

It is obvious from the figure that there are mainly poorly and strongly negative children in the group and only 4 were positively disposed to the dental treatment initially.

The children’s response to the methods was assessed by means of a short interview after the manipulation and their answers were referred to already depicted four behavioral types. Although most of the children were referred to 3-rd and 4-th groups according to Frankl scale, there was no one with negative response to the manipulation and not allowing its performance. The differentiation of the children according to their response to the cavity excavation with Carisolv is shown in the next Figure №3.

![Figure №3](image)

It is clear from the figure that all children are positively disposed to the manipulation with Carisolv - 1/3 of them are strongly positive, 1/3 are well-disposed to the manipulation but get bored with its duration, only two children do not give a definite answer due to small age and just four prefer the drill. It is curious to mention that they are from the group of strongly and poorly positive.

2. Depiction of the carious lesions prepared applying controlled chemo-mechanical excavation with Carisolv.
The cavities of 8 permanent first and 30 deciduous molars have been prepared - 6 approximal and 22 occlusal caries (Figure № 4).

All carious lesions have been cavitated and irreversible. Two of the lesions were next to the beginning of the dentin (D2) and the rest were in the dentin (8 - D3a, a 20 - D3b according to Peneva) (2) (Figure №5).

With two of the cavities (D2) the preparation took 15 minutes. With all the rest dentin caries it took 20 - 25 minutes.

3. Making a report for controlled chemo-mechanical excavation with Carisolv. Based on the clinical observation that have been done a report was made for controlled chemo-mechanical excavation with Carisolv:

   Report for controlled chemo-mechanical excavation with Carisolv:
   
   Anaesthesia is not required while performing cavity preparation with Carisolv;
   
   Ex tempore merging of the liquid from both syringes of Carisolv (stays active till 60 min.);
   
   Seclusion of the operating field - with child coferdam or hygroscopic rollers. It is required to be used while working with Carisolv due to its active ingredient - natrium hypochloride;
   
   Immersion of the excavator in the liquid and dropping in the cavity, waiting for a minute;
   
   Disclosure of the carious lesion with excavator №2 (The procedure is performed using original excavators of Carisolv system). The disclosure of the carious focus could also be achieved with fissure turbine bur according to the operator’s estimation;
   
   Again dropping of Carisolv and waiting for
Scraping the infected dentin with excavator №3 and 4;
Again dropping of Carisolv and waiting for 30 seconds
Scraping the line between the enamel and dentin with excavator №1;
Scraping the cavity bottom is finished by means of excavator №1.
Scraping the infected dentin at the cavity bottom could be controlled additionally by staining;
Microinvasive method requires conservation of affected dentin and stimulation of remineralization applying biologically active obturating materials (GYTs) and calcium-hydroxide liners, etc.

4. Observation of the latest outcomes from the treatment (in 6 months). 18 of the children have been observed for the first months (2 cavities of permanent molars and 25 of deciduous ones - 1-D2, 16-D3a and 10-D3b). The assessment criteria depicted in the methods have been used. The generalized outcomes are shown in the next table.

The obtained outcomes indicate that any significant complications and adverse effects have not been observed for the first 6 months after MI treatment of the caries applying chemo-mechanical excavation with Carisolv.

With 6 of the caries (D3b - 5 of the deciduous teeth and 1 of a permanent tooth) newly-formed dentin over the pulp has been observed on X-ray. We do not have comparative X-ray data for the rest.

Discussion: Microinvasive treatment of the caries applying chemo-mechanical excavation with Carisolv is a very appropriate method for children. The outcomes indicate that although the cavity excavation with Carisolv takes longer, the negative and strongly negative children according to Frankl scale are well-disposed to the method.

The controlled excavation with Carisolv is an appropriate method for cavity preparation with both deciduous and permanent child teeth and with carious lesions of different location and depth. The utilization of Carisolv patent excavators facilitates scraping the difficult of access line between enamel and dentin and the pulp base of the cavity is treated under control up to the complete removal of the infected dentin and conservation of the affected. Sticking to a certain operative report is a must for the method success. The latest outcomes which have been observed prove the method effectiveness and the deposit of reparative dentin in some cases is an issue that has to be studied in the future.

Conclusions:
Cavity excavation with Carisolv is a method which is accepted perfectly by children, especially negative and strongly negative children.

The method is recommended to be applied with caries of different depth and localization and

<table>
<thead>
<tr>
<th>Assessment criteria</th>
<th>up to 1 month</th>
<th>3 months</th>
<th>6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain while chewing</td>
<td>3 - slight sensitivity on the first day</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Pain caused by warm and cold</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Spontaneous pain</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Faulty obturation</td>
<td>no</td>
<td>2 - faulty edge of obturation</td>
<td>no</td>
</tr>
<tr>
<td>Caries referred to the obturation</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Newly-formed dentin over the pulp</td>
<td>no</td>
<td>no</td>
<td>Yes (doc.Rogr), With 6 caries, D3b</td>
</tr>
<tr>
<td>Recurrent caries</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
<tr>
<td>Complicated caries</td>
<td>no</td>
<td>no</td>
<td>no</td>
</tr>
</tbody>
</table>

*Table №2 Assessment of the treated caries for the first three months*
of both permanent and deciduous teeth.

For method application Carisolv patent excavators should be used in definite sequence depicted in the operative report.

Complications and adverse effects have not been observed for the first 6 months after MI treatment of the caries applying chemo-mechanical excavation with Carisolv.

Clinical cases:
References

2. Пенева М. Зъбният карис през 21-ви век. Изд. Изток-Запад, 2008, 290 стр.
3. Шияков К., Химно-механична система за отстраняване на карисния дентин Carisolv, Зъболекарски преглед, 2005, 87(2), 136-139.

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Questionnaire survey on oral hygiene awareness of children with hearing impairment

L. Doichinova¹, M. Peneva²

Summary

One of the key directions in oral health preventive programs is oral hygiene maintenance. There are additional risk factors for the children with special health care needs, which endanger more heavily their oral health compared to other children.

The oral health care education of children with impaired hearing is significantly hampered by the difficulty to get their feedback.

Objective: The goal of this survey was to study the awareness level among these children on issues related to oral hygiene.

Materials and methods: The questionnaire type survey covered 200 children with hearing impairment within the age range from 7 to 12 years. We used a Survey Card, appropriate for the age of the children.

Results and conclusion: The survey results revealed weak awareness of children with hearing impairment. It was found that they used only certain toothbrush movements, which illustrated both lack of knowledge and educational problems. This highlights the need for special education, tailored and adapted for the hearing defect of these children. Special visual aids are used to teach them oral hygiene procedures, because these children “hear” with their eyes. It is necessary to select and design illustrative training materials by adopting modification of the “tell, show, do” method into “show, do” practice.

Key words: Hearing impairment, education, oral hygiene, communication, oral health.

Introduction

The children with hearing problems are children having special health care needs (6, 7, 13, 19, 24, 26). The hearing defect has its devastating effect on their communication with others (2, 3, 13). The hampered communication changes the individuality of the child and is a reason for reduced cognitive abilities, impaired intellectual capacities and difficult social accommodation (1, 2, 3, 14).

Good oral hygiene maintenance is one of the key directions of oral health preventive programs for children with special needs (4, 5, 13, 17, 18, 19, 20). The oral health care education of children with hearing disability is hampered due to broken communication channels (6, 7, 21, 22).

Dentists do not have adequate information on the communication obstacles, faced by these patients (6, 7, and 8). The inadequate communication may create both problems with the proper fulfillment of the instructions and lack of motivation (2, 3, 10, 28). The misinterpretation of the provided information may result in hampered mastering of new skills and knowledge in this group of children (6, 2, 7, 21, 22). One key barrier in the communication process with the persons, having hearing disability is the use of sign language, which is simplified, with a different structure and smaller vocabulary (1, 9, 6, 15, 16, 21, 22, 25). It is necessary to eliminate all obstacles in the communication process with these patients and conduct spe-
cial educational sessions, tailored specifically to this group of children with special needs (11, 12, 23, 24, 27).

The study we held with such children for assessing their oral hygiene revealed that a large part of them had poor baseline oral hygiene status and problems with the proper performance of the instructions, given during their motivation and education in oral hygiene rules and procedures due to difficult communication with this population.

This gave us enough grounds to set the objective of the present study to check the knowledge and awareness of these children on dental health and oral hygiene issues.

For the fulfillment of this objective we formulated the following specific tasks:

- To use a Survey Card to objectively check the oral health knowledge of children with impaired hearing.
- To assess the results of this questionnaire-based survey.

Materials and Methods

The questionnaire-based survey covered 200 children with hearing problems, 112 boys and 86 girls within the range of 7 to 12 years of age. A specially developed survey card was used. It included 12 questions, using common language, suitable for the age group of these children:

- Is tooth brushing important for having
healthy teeth;
• How many times a day they brush their teeth;
• When do they brush their teeth in the morning – before or after breakfast;
• When do they brush their teeth in the evening – before or after dinner;
• What can help eliminate the tooth decaying microbes;
• Most frequently used by them movements during tooth brushing;
• Food preferences;
• How do they take care of their teeth;
• At what interval one should have check up visits to the dentist;
• At what interval the toothbrush should be changed;
• What do we brush off from our teeth with the toothbrush and toothpaste;
• Why the teeth get caries.

Results and Discussion

The results of the completed questionnaire-based survey are presented on Fig. 1, 2, 3, 4, 5 and illustrate the knowledge level of the study subjects.

Fig. 1 illustrates children awareness on the significance of oral hygiene and dental health. The results are alarming and show that 84.5% of the children are not aware of its significance to dental health, while only 5.5% have information, and 10% cannot give an answer. This indicates that no oral health education has been provided to these children, probably due to problematic communication, which creates serious difficulties in mastering skills and knowledge, as well as other factors of objective and subjective character.

Fig. 2 illustrates the oral hygiene habits of children with impaired hearing. The obtained results reflect a very troublesome fact, that large part of them - 61.5% brush their teeth once a day, while 25.5% do so seldom during the week, when it occurs to them and only 13% brush their teeth twice a day. The established irregular oral hygiene maintenance in this group of children expose their oral health at a serious risk, which makes it necessary to have actively structured motivation and education for developing proper oral hygiene habits and routine.

Fig. 3 illustrates children’s oral hygiene routine in children with impaired hearing.
Fig. 3 reflects the daily oral hygiene habits of the children, illustrating that a large portion of them brush their teeth after they get up in the morning - 92% and only 3.5% after breakfast, all of them brushing their teeth before going to bed in the evening. A small share of the children in the study - 4.5% cannot give an answer when they should brush their teeth. The results definitely indicate that this oral hygiene practice of the children will result in higher adverse effect of the risk factors in their oral cavity.

Fig. 4 illustrates the most frequent toothbrush movements, used by the surveyed children. It has been established that the most frequently used movements in brushing their teeth are the horizontal - 88.5%, followed by the circular - 7.5%, vertical movements are present only in 3% of the children and only 1% of them combine all the listed movements consecutively one after another. These results once again confirm the fact, found in our study of their oral hygiene that the children with hearing problems do not have well-developed, proper oral hygiene skills and information on this subject. They have not been trained to use combined movements of the toothbrush in maintaining their oral hygiene.

The predominance of only certain type of movements will bring about unsatisfactory brushing of some tooth surfaces, particularly those more difficult to reach and it will be a prerequisite for increased harmful effect of the tooth plaque in these sections, where the toothbrush and toothpaste have not cleaned it.

Fig. 5 gives the results, illustrating the food preferences of these children. The chart analysis shows that the relative share of those with preferences to carbohydrate type of food is large - 82.5%. The relative share of those, consuming predominantly fruit and vegetables is very small - 6%, while from all the rest - 8.5% of the children prefer fruits and only 3% have their preferences only to vegetables. The consumption of cariogenic food, such as carbohydrates with the majority of children will result in worsening their oral risk profile.

As to the awareness of the children on having their teeth brushed in the evening (question No.4) - 67% of them have answered correctly, yet this does not correspond to the results, obtained from the assessment of their oral hygiene, which is indicative of the lack of adequate oral hygiene habits.

All other questions (No 5, 8, 9, 10, 11, 12) from the questionnaire card were difficult to the children and the majority of them didn’t respond. This very fact indicates that for the children with impaired hearing it is absolutely necessary to develop a special educational system, using the methods of visual pedagogy.

Conclusions

The awareness of children with impaired hearing on oral hygiene and its significance to dental health is unsatisfactory;

It is necessary to use the methods of visual
pedagogy and develop materials to be used in the process of educating these children.

References


Klepac R., McDonald M. Reaction to pain among subjects high and low in dental fear. J Behavioral medicine 1990; 3(4); 373-84.

Klinberg G. Behavior management education in Paediatric dentistry, Paper for the 4th interim Seminar of the EAPD 2005, April; 22-23.

Kumar S., Dagli R., Mathur A., Jain M., Duraiswamy P., Kulkarni S. Oral hygiene status in relation to sociodemographic factors of children and adults who are hearing impaired, attending a special school. Spec Care Dent 2008; 28(6); 258-64.


Oredugba F. Use of oral health care services and oral findings in children with special needs in Lagos, Nigeria. Spec Care Dent 2006; 26; 59-65.


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Oral hygiene status of children with impaired hearing
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Summary
The hearing impairment among the children is an obstacle for communication, getting adequate health information and developing oral hygiene habits, which lay the foundation of oral health.

Children with impaired hearing are a major portion of the group of children in need of special care. This care necessitates special approach in providing health care information and establishing appropriate health-hygiene practices, both setting the frames of preventing oral diseases.

Therefore the task of the pediatric dental doctors is to design specifically tailored methodologies for oral diseases prevention, which to take into consideration the basic impairment and be able to overcome it.

Objective: The conducted study aimed at establishing the oral hygiene level in a group of children with hearing impairments, which to serve as basis for developing special methodology.

Materials and methods: The study covered 200 children with hearing impairments within the age range from 7 to 12 years. The assessment of oral hygiene status was done by using the index of Green – Vermillion, while the results were compared to those of a control group, consisting of healthy piers.

Results and conclusions: The reported oral hygiene status results revealed unsatisfactory oral hygiene level. They are credibly poorer compared to those of their healthy comparators from the control group and illustrate low effectiveness of the „tell’ show’ do” method, due to the hampered communication.

Key words: Children with hearing impairment, oral hygiene, oral hygiene – index, communication, tooth brushing.

Introduction
Oral hygiene is of enormous preventive importance for the dental health of children with special health care needs (10, 26, 27, 24). The majority of these children grow up without having preventive care, health education and adequate treatment (18, 23, 28).

Children with hearing problems constitute large share of this population with special needs (26, 27, 8, 29, 30). The existing underlying problem in this group neglects oral health care, which causes new sufferings (8, 9, 17, 32). Therefore oral hygiene for them is important and obligatory prevention aspect, which can preserve their oral health (4, 5, 6, 7, 8, 12, 15, 17). The motivational program and controlled brushing of the dentition is an integral part of the oral health care education (21, 24, 25, 34).

Children with hearing defects have interrupted communication due to the specificity of their problem (1, 2, 14, 16, 22, 31). The inadequate communication may be a serious reason for their inability to properly fulfill the instructions, provided during oral hygiene education, as well as cause for fair motivation (11, 3, 13, 17, 19, 20). The communication barriers create serious difficulties in mastering proper skills and relevant knowledge (17, 19, 33, 35, 36, 11). In order to
overcome these difficulties joined effort of dentists, psychologists, pedagogues and parents are needed.

The objective of the study, held by us, was to establish the oral hygiene level in children with hearing problems – which to serve as a foundation for developing special methodology of oral hygiene education. For the completion of this primary objective we set the following specific tasks:

To have an assessment of the baseline oral hygiene status of children with impaired hearing and to compare it with that of their healthy peers.

To use standard motivational oral hygiene program in both groups for a period of one month.

To determine and compare the oral hygiene status on the two groups after a month.

We statistically processed all data by applying variation analysis, calculating average values, standard deviation, and standard error. We used the t – criterion of Student-Fisher, reporting as statistically valid only those differences at $P < 0.05$. The results obtained were presented in Tables and Charts.

Materials and Methods

The study covered an experimental group of 200 children with hearing problems age 7 to 12 years, 112 boys and 88 girls and a control group of healthy children at the same age.

The oral hygiene status of both groups was assessed using the simplified oral hygiene index of Greene Vermillion – OHI-S:
- no plaque;
- plaque, covering 1/3 of the vestibular tooth surface;
- plaque, covering 2/3 of the tooth surface;
- plaque, covering more than 2/3 of the tooth surface.

For both groups we used standard motivational program for a period of one month, dividing the children in groups of 10. The whole study continued one full year, encompassing correction of the existing oral hygiene skills, the children being subject to oral hygiene rules education for a period of one month.

The motivation was performed based on a standard scheme of introducing various elements and changing their places in each re-motivational session to avoid the process of satiation:

- Visualizing tooth plaque by means of developing staining tablets and explanation of the obtained results; its demonstration by scraping, underlining its impact on dental health, aesthetic appearance and social contacts;
- Demonstrating the properly combined toothbrush movements over the dentition on a plastic model, showing the more difficult to reach sectors and the way they should be brushed;
- Demonstrating gingival bleeding by means of floss/ tooth probe;
- Demonstrating good oral hygiene in a child, who can serve as exemplary model;
- Showing motivational slides and animated videofilm;
- Using picture tests.

The program duration is 15 minutes, 5 of which are devoted to demonstration. The re-motivational interval is two weeks.

The motivation in the experimental group was performed by a dental specialist, jointly with surdo-pedagogue, using sign language. Children from both groups were instructed to brush their teeth for three full minutes at home after breakfast in the morning and before going to bed in the evening.

Before the groups entered the motivational program assessment of their baseline oral hygiene status was performed.

Results and Discussion

In fulfillment of task No. 1 we assessed the baseline level of oral hygiene status for the children with hearing problems and compared it to that of their healthy peers. The results are entered in Table 1.
Table 1. Baseline OHI-S prior to motivation

The baseline level of oral hygiene status for deaf children, taken at the start of this study falls within the range of poor oral hygiene, having an average OHI-S value of 2.24, while this for the healthy controls is credibly lowers - 1.91 (T = 7.85, p<0.001). This illustrates that children with hearing impairments have serious problem in oral hygiene maintenance, which threatens their oral health.

2. While implementing task No. 2 we applied oral hygiene motivational program in both groups for a period of one month.

Table 2 OHI-S after motivational program

The results of its level, reached after the period of motivation are recorded in Table 2.

The results after the motivational program demonstrate credible significant difference of the end point results between the deaf and the healthy subjects (T=13.25, p<0.001). This clearly demonstrates that deaf children experience serious problem in absorbing the standard motivational program due to the existing communication disruption and difficult conveyance of full information by the sign language used.

3. During the implementation of task No. 3 the oral hygiene status in both groups was compared after one month period.

The children were divided depending on the OHI-S values in groups of:
- children with OHI-S - 0 to 1 – good oral hygiene
- children with OHI-S - 1 to 2 – fair oral hygiene;
- children with OHI-S - 2 to 3 – poor oral hygiene.

Chart 1 - OHI-S prior and after motivation

Chart 1 reveals that after having the motivation and oral hygiene education these two groups have an improvement of their oral hygiene. This is being proven by the credibility of differences in the values of OHI-S in the baseline and final assessments, which for the deaf children is (T= 10, p <0.001), while in their healthy peers (T=14.6, p<0.001). Irrespective of the credible oral hygiene improvement in both groups, the OHI-S values with the healthy controls exceed 1, which witness still unsatisfactory oral hygiene, while with the deaf children the improvement stays within the value limits of 2, which is at the borderline of poor oral hygiene.

The result from the comparison of the OHI-S baseline level of healthy children and the end result in those with impaired hearing is explicitly expressive. Lack of significant difference (T=0.23, p<0.05) was established, which illustrated that the hygiene status end value in deaf children after the motivational period is almost equal to the baseline oral hygiene status in healthy children prior to motivation. This is a troublesome fact and it urgently requires development of a special oral hygiene educational methodol-
ogy for the deaf children, using the methods of visual pedagogies.

The baseline OHI-S results for the deaf and the healthy children are presented in Charts 2 and 3.

Within the group of poor oral hygiene and OHI-S values of 2 to 3 fall 75.5% of the deaf and 40.5% of the healthy children, which is an evidence of strongly neglected oral care, precondition of high caries development risk. This difference between the two groups is in favor of the children with impaired hearing (T=2.78, p<0.05). This result is troublesome as it becomes evident that almost two thirds of the deaf children have strongly neglected oral hygiene.

Another quite alarming fact is that large number of healthy children have definitely neglected oral hygiene.

The relative shares of end point OHI-S, obtained after one month motivational period are illustrated in Charts 4 and 5.

Comparing the data of these two groups it is evident that children with good oral hygiene are an insignificant part in both groups – 5.5% in the group of the deaf children and 7% of their healthy peers. This fact indicates that a very small share of children has good oral hygiene and low tooth caries development risk. No significantly valid difference is being established in the two groups (T=0.3, p>0.05).

Within the second group of children, where the OHI-S values vary in the range of 1 to 2 significant difference is found between the deaf and healthy children. While in the deaf children group the share is only 17%, the majority of the healthy children, namely 52.5% have unsatisfactory oral hygiene.

Discussion

Comparing the results illustrated on Chart 4 with those on Chart 2 and the results of Chart 5 with the ones, indicated in Chart 3, it has been
established that the number of deaf children with good oral hygiene has not significantly increased by 1% only – from 5.5% before the motivation to 6.5% after the completion of its one month period, while for the healthy children there is a significantly valid increase of the number of those having good oral hygiene – from 7% prior to training and motivation to 27% after a month (T=2.91, p<0.05).

Significantly valid difference is being found in comparing the percentage ratio between the deaf and the healthy children with good oral hygiene after motivation (T=3.1, p<0.05).

The ratio in the second group with OHI-S value between 1 and 2 has also been changed. It has significant increase of the deaf children (T=4.12, p<0.001), which indicates that motivation has provided minimal results, yet the improvement does not fall within the boundaries of a serious reduction of caries development risk. Also the number of healthy children falling within this group has increased, yet there is lack of significant difference in the percentages between the deaf and the healthy subjects (T=1.01, p<0.05).

After the process of education and motivation the group of children with poor oral hygiene having OHI-S value between 2 and 3 has definitely gone down, the data for the deaf segment being (T=13.03, p<0.001) and for the healthy one (T=10.69, p<0.001). Nonetheless deaf children with poor oral hygiene constitute one third of all children, which shows that this type of oral hygiene education is not adequately effective to them. Healthy children with poor oral hygiene have significantly decreased in number after the process of motivation and education and are credibly less than deaf children (T=7.72, p<0.05). These results illustrate that motivation and education are suitable for healthy children, while for the deaf ones a more suitable method, taking into account the communication problem, should be tailored.

Conclusions:
All studied subjects have fair baseline oral hygiene.

Deaf children have definitely poorer baseline oral hygiene results.

All the children improve their oral hygiene after a period of motivation and education.

Deaf children do not improve adequately their oral hygiene.

The standard motivational and educational oral hygiene programs are not adequate for application in groups of deaf children due to the disturbed communication and difficulties encountered in the process of relaying the necessary information.

It is necessary to develop special oral hygiene visual educational system for deaf children.

References


Dye B. The relationship between selected measures of periodontal status and demographic and behavioural risk
Oredugba F. Use of oral health care services and oral findings in children with special needs in Lagos, Nigeria. Spec Care Dent 2006; 26: 59-65.

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Application of photoinfrared photobiomodulation (λ-904 nm) after preprosthetic preparation of patients for permanent fixed structures

L. Bayrakova

Summary

After preprosthetic preparation of patients for permanent fixed structures we usually observe impaired integrity of the epithelium, flushing, swelling, bleeding and pain.

The aim of our study was to investigate the therapeutic effect of Photoinfrared Photobiomodulation (λ-904 nm) on the damage of soft tissues in the mouth. Over 1 year period of treatment we have investigated 15 patients in good general health after prosthetic preparation for permanent fixed structures, 7 female and 8 male.

For this purpose we used laser apparatus SIX Laser TS (Atlantis, Bulgaria), representing the Ga-Al-As Infrared laser (IR) probe, frequency line: 0-4000 Hz, λ-904 nm, P-18W. We preferred to apply the method of resonance Photoinfrared Photobiomodulation (λ-904 nm) as method of action to accelerate the regeneration and neuromuscular relaxation of the chewing apparatus of patients treated.

The authors are irradiated the patients using infrared laser light with a specific frequency mode in order to achieve fast tissue cell response and on the organ level also. The authors have been preferred methods of sedation, tonification and magnetic laser therapy for treatment effects on electromagnetic structure of the human body and traced their therapeutic effectiveness for one year. Healing effect of the laser is measured at the following clinical criteria: redness, swelling, bleeding, impaired integrity of the epithelium and pain.

Photodynamic laser therapy can be widely used in Prosthodontics. The healing effect of this therapy is very good and depends on the particular physical parameters.

Introduction

In the last few years there is a huge interest in studying the laser photobiomodulation – LLLT (red and infra-red spectrum) with the most effective wave length λ-680-904 nm.

The infra-red photo modulation is a resonance effect on the tissues, engendering a physiological response on cellular level, and it effects the stimulation of the bone growth, the immune system, the relieving of pain, as well as the neuromuscular restoration of the motor system. The basic therapeutic effects of the infra-red photo modulation are anti-inflammation, analgesic, as well as stimulation of the cellular activity and the bone growth (9). They are due to the activation of the components of the mitochondrial respiratory chain, which leads to a cascade of cellular processes, as well as to an acceleration of the enzyme and cellular activity (1, 2, 3, 4, 5, 7, 8). The basic bio-electric power of the infra-red photo bio-modulation is to maintain the potential of the cellular membrane which stops the pain signalization to reach the nerve centers. This is due to the effectiveness of the sodium-potassium pump, as well as to the high level of adenosine tri-phosphate, as a result of bio-chemical reactions (11).

The application of lasers in prosthetic dental medicine is a subject of many clinical and science works (10).

The most frequent problems with the pre-
The aim of the present work is the study of the effect of infra-red photo bio-modulation with length of the wave $\lambda$- 904 nm and the curative effect on soft tissues healing in the mouth after the preparation of teeth for permanent fixed structures.

**Materials and methods**

In an one year period of time we conducted a treatment of 15 patients – 8 men and 7 women, with parodontal problems who need a protetical treatment with fixed constructions.

We used a laser apparatus SIX LASER TS of the Bulgarian company Atlantis, which is a gallium arsenide laser. The apparatus has a red probe (0-4000 Hz, $\lambda$-904 nm, P-18W), an infra-red probe and an infra-red multi diode head-stock with coherent light (650 nm , 750 nm, 875 nm and 904 nm). The total power of the multi diode head-stock is 321 mW.

We used a method created by Prof. Kamenova.

The first visit includes intraoral laser therapy: SEDATIO
- 900 Hz, 4 min, E-4 J/cm, P-18W.
- 300 Hz, 4 min, E-1 J/cm, P-18W.

The next five procedures – tonificatio local: - 4000 Hz, 4 min, E-17,28 J/cm, P-18W.
For the first 4 days the treatment was combined with:
- 20 Hz, 3 min, E-0,06 J/cm, P-18W. At the fifth day:
- 40 Hz, 3 min, E-0,12 J/cm, P-18W for each jaw.

The treatment includes magnetic laser therapy with multi diode head extraoral: - 4000 Hz, 1 min, E-4,32 J/cm, P-18W for each jaw.

**Results and discussion**

For our purpose we used the following clinical criteria: reddening, swollenness, bleeding, impaired wholeness of the epithelium and pain.

Before the treatment with infra-red laser light ($\lambda$-904nm) we observed the following frequency of objective symptoms: reddening - 67%, swollenness - 47%, bleeding - 27%, impaired wholeness of the epithelium- 100% and pain - 67%. The results are on fig. 1.

After the treatment with $\lambda$-904nm we concluded that only 1% of the patients had reddening and swollenness, and no one had impaired wholeness of the epithelium and bleeding.

The patients reported comfort feeling and...
absence of pain. The results are on fig. 2.

On the grounds of these results we recommend infra-red photobiomodulation with \( \lambda = 904\text{nm} \) for treatment of impaired soft tissues, reducing pain and bleeding and inflammation process.

**Conclusions**

LLLT can be used in the prosthetic dental medicine, but this therapy depends on specific physical parameters (10).

The conclusions we can make are that the effectiveness of the infra-red laser light \( \lambda = 904\text{nm} \) is based on stimulation of the cellular mitochondria, high level of adenosine tri-phosphate and stimulation of cellular mitosis. This leads to increased oxygen consumption and activation of the cellular breathing and strong anti-inflammation effect.

The other mechanism of the infra-red photobiomodulation with \( \lambda = 904\text{nm} \) is the increased level of prostaglandiny, the activity of the fibroblasts, stimulation of the nerve-muscular restoration of the motor system, as well as good blood circulation.

In our opinion this is a way to reduce pain and restore the damage of the epithelium integrity.

**References**


2 Campana VR, Moya M. The relative effects He-Ne laser and meloxican on experimentally induced inflammation laser therapy. 1999; 11(2): 36-48


10 Parker S: The use of lasers in fixed prothodontics. Dental Clinics of North America, 48(4), 971-998


CASE REPORTS

Eosinophilic granuloma of the mandible - case report

E. Alexiev¹, Hr. Mihaylova², A. Bobeva³

Introduction

Eosinophilic granuloma (EG) is a benign tumour like form of Langerhans cell histiocytosis, localized predominantly in bones without involving internal organs*13*

It was described in 1913 by the Russian pathologist Taratinov. 1953 Liechtenstein introduces “Histiocytosis X “ as a term including three entities with a common histological findings – different manifestations of the same pathological process- damage of the reticulo endothel system.

These are Eosinophilic granuloma (localized form), Hand-Schüller-Christian syndrome (chronic disseminated form) and Letterer-Siwe syndrome (acute and subacute disseminated form). They are characterized with intense proliferation of reticulo endothel cells which infiltrate bones, skin, mucosa and internal organs. “X” means unknown ethiology of syndromes.

Histiocytosis X is non neoplastic disease; it’s characterized with extreme proliferation of bone marrow histiocytes (Langerhans cells), different number of eosinophilic leucocytes, neutrophilic leucocytes, lymphocytes, plasmatic cells and multiple nuclei giant cells which infiltration causes destruction of tissues.

1987 the term Histiocytosis X is replaced by Langerhans cell histiocytosis (LCH). (1,14)

LCH is a rare disease which affects children predominantly – annually - 5 cases per million and 1-2 cases per million in adults.

Eosinophilic granuloma is approximately 60-70 % of LCH cases. This form is the most common and with good prognosis form of LCH, mainly met in childhood.(3,5,10,14)

The ratio women : man is 1,1:1 to 4:1
Eosinophilic granuloma is a disease with unknown etiology. It is characterized by single or multiple bone changes in one or many bones (ribs, cranium, vertebra and facial bones). It can involve or not soft tissues and could be without involvement of internal organs. Solitary and multifocal ratio is 3:1 (3,5,8,9,12)

The most frequent place in the head and neck area is cranium, maxilla, mandible and temporal bone. Mandible is affected in 23-97%, more frequently in the body and the angle. (2,3,9,10)

First clinical symptoms of EG usually develop in the oral cavity and bone changes are twice frequently in comparison with soft tissue changes.(4,13) There are reports for existence of oral findings without bone changes.(7)

Oral findings are in the gingiva, hard plate and floor of the mouth cavity. They include local swelling, mucous ulceration gingival inflammation, leukoplakia, and bone loss with dental hypermobility.(6,13).

The oral lesions may be the earliest clinical signs of EG and in many cases the jaw and mandible may be the only sites involved. According to the literature data the incidence of oral lesions is about 77%. (13) That’s why early symptoms of Eosinophilic granuloma in maxillo-facial region manifested in jaw area can be first recognized by dental professionals.

Pereda C. et al. have summarized the changes of LCH into mucosal and bone changes:

Bone changes usually involve the distal regions and the ramus of the mandible. When two or more lesions persist, they usually are in the alveolar crest and they have different shape. Solitary bone lesions are beside the alveolar crest; sometimes multiple alveolar lesions are found.

Mucosal lesions are ulcerative, ovoid or round lesions, with erythematous, inflamed borders, painful on palpation. Lymphadenitis and in 30% cervical lymphadenitis accompany the oral symptoms.

There are some difficulties concerning the early clinical and radiological diagnose of EG due to the nonspecific clinical and radiological symptoms. A lot of questions concerning the way of treatment are discussed in the literature. Usually it is complex - surgical approaches, antibiotic and corticosteroid therapy, cytostatic drugs, radiotherapy, chemotherapy etc. (1,3,8,11,13,14,16)

Case report

51 year old man entered the clinic with pain and swelling of the left mandible and limited opening of the mouth from a few months accompanied by swelling of gingival and tooth hypermobility of 36, which was extracted. Years ago an “operation of the gingival was done.

The clinical examination shows facial asymmetry due to the swelling of left mandible and mental region; skin was normal. The ridge of the mandible couldn’t be felt.

Local status: anatomical breakage of the mandible during palpation in the molar region with pathological movement and dislocation accompanied by pain.

The intraoral examination revealed poor oral hygiene, swelling of the alveolar crest; the colour of the mucosa - without changes. Colourless granulations easily bleeding from the place of the extracted tooth, 43 and 44 - not stable.

X ray examination: Edentulous mandible. Osteolysis from the left angle to the right molars including roots of 43 and 44. It is with sharp polycyclic borders without osteosclerosis. Compacta substance grows thin in left mandible reaching 2-3 mm in the mental area. The level of the premolars can be seen symptoms of fracture: fracture line, dislocation etc. In conclusion – X ray data for tumourlike formation and pathologic fracture. Differential diagnosis with benign
Fig. 1 X-ray before the operation

Fig. 2 X-ray after the operation

Fig. 3

Fig. 4
odontogenic cysts and tumors could be made: keratocyst, osteoblastoma, adamantinoma etc.

Operational protocol: lack of alveolar bone from 36 to 44; in individual sections—osteolysis of lingual and palatal plates. Resection of the mandible has been done including the area of the left mandibular angle to 44 using titanium plate.

Pathohistological examination; contains skin, soft tissues, parts of spongious and compact bone. Derma and bone are infiltrated with histiocytes (Langerhans’ cells), eosinophils, lymphocytes, plasmocytes etc; there are proliferation of vessels and regional haemorrhages (fig. 3 ,fig.4).

Immunohistological examination: CD 45 – positive reaction in eosinophils, lymphocytes and macrofags; S-100 positive reaction for the most of Langerhans’hystiocytes . In conclusion: hystological and immunohystological data for Langerhans cell histiocytosis (LCH) - Eosinophilic granuloma.

Discussion

Eosinophilic granuloma in the maxillo-facial region is an entity with a slow course, nearly asymptomatic and without any complaints. In the jaw bones it is characterized with erythema, swelling, ulceration, gingival necrosis, bone loss and mobility and loss of teeth.- it has the symptoms of advanced parodonthopathy. If there is secondary infection, the clinical picture resembles chronic osteomyelitis of jaws. That’s why the radiological and hystopathological investigations are so important for the diagnosis of Eosinophilic granuloma.

We can see unifocal and multifocal osteolysis with sharp, smooth and polycystic borders in EG. Reactive bone changes - osteosclerosis and periostal reaction usually are missing.

X ray symptoms depend on the localization in the bone and the degree of development of the process. If a large osteolysis persists – there is a big bone defect usually with pathologic fracture, as in the described case. In maxillo-facial region when localization is in the alveolar crest X ray findings resemble aggressive and rapidly progressive parodontopathy. The lack of pahtognomonic symptoms makes the clinical and radiological diagnose difficult.

Authentic diagnose EG is done using hystopathological and immunohistochemical analysis – positive reaction for typical hystiocytic protein S100 and cell markers CD 45 are observed as in our case.

Surgical treatment of EG localized in jaws is a method of choice – has to be done in radical borders – removing the bone and soft tissues. The bone defect is replaced at one - stage with explant or transplant auto or alo transplant). Distraction therapy is made in cases when there is enough bone available.

Radiotherapy and chemiotherapy could also be done separately or in combination with surgical treatment. ( 1,3,8,11,14,15,16) Further observation of EG is done in Oncological and Haemothological Clinics.

Conclusion

Literature data shows as well as our case present that EG is a significant diagnostic problem for clinical practice. Often the dentist is the first one to meet the oral manifestations of EG.

The complications in maxillo-facial region are connected with bone tissue loss, sometimes leading to pathologic fracture of the mandible.

The presented EG case shows that in cases of localized oral changes we must also have in mind the localized form of EG of jaws.

References


Abbreviations:
EG - Eosinophilic granuloma
LCH - Langerhans cell histiocytosis

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Dental pulp tissue has a great healing and regenerative potential. Different factors (caries, cavity preparation, trauma) can produce pulpal response (inflammation—mild or severe, dentin regeneration, pulpal necrosis). The most important goal of the dental pulp treatment is saving the integrity of dentin-pulp complex, its function and pulpal vitality. Direct pulp capping is the possible way for solving this problem.

Many investigations have been made and many pulp capping materials have been tested. Some of them like calcium hydroxide, MTA have been used successfully for many years and they are even gold standard for the pulp capping procedures. There is an issue if there is anything else that might be used as a pulp cap agent and that might lead to more predictable results. Nowadays, scientists try to find the answer of this question in using other materials, such as enamel extracellular matrices, bioactive amelogenines, stem cells, growth factors, enamel matrix derivatives and many others. For the treatment success the pulp capping agent should be biocompatible, nontoxic, to induce cell proliferation and differentiation. It is important also the pulp to be protected against microbial infection.

The investigations show there are many problems that need to be solved and greater possibilities for choosing different pulp capping materials.

Key words: Dental pulp, direct pulp capping, pulp capping materials

Summary

Dental pulp tissue has a great healing and regenerative potential. Different factors (caries, cavity preparation, trauma) can produce pulpal response (inflammation—mild or severe, dentin regeneration, pulpal necrosis). The most important goal of the dental pulp treatment is saving the integrity of dentin-pulp complex, its function and pulpal vitality. Direct pulp capping is the possible way for solving this problem.

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One of the main purposes in dental pulp treatment is saving the dentin-pulp complex function and its morphology as efficiently as possible(5). Dental pulp is a kind of connective tissue that is placed in dental endodontium. It consists of intercellular components, cells (fibroblasts and odontoblasts) and its unique capability is to produce reparative dentin when there are optimal environmental factors for that (34). From a clinical point of view direct pulp capping is a method that stimulates the reparative function of the pulp. This clinical approach can be used in the cases of traumatic injuries and collisio of the permanent teeth and when the caries removal leads to pulp communication (12). These are the cases when the dentist is faced with the dilemma of saving the tooth vitality or starting an endodontic root canal treatment. There are some important points that should be considered before making the right decision: accurate diagnosis, anamnesis data, pulp communication size, bleeding control, periodontal status, distrophic pulp changes, general health of the patient, patient’s age, electroodontodiagnosis data, informed consent (1).

In most of the cases the preferred treatment is the endodontic root canal treatment. The reasons for choosing that approach are related to expected complications after direct pulp capping. These complications might be severe pain, obliteration/calcifying of the pulp chamber or even the root canals which might lead to a very difficult endodontic treatment in the future.

No matter if the decay removal had left pulp communication or not, the pulp would not be unaffected. Each intervention used in

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operative dentistry like preparation, medication or obturation, might cause some pulp reactions. The aim of the dental clinician is, for these pulpal responses to be reversible and the end of all these reactions to be the healing process. When a pulp communication occurs one of the most important healing factors is the pulp-capping material. The healing process is presented by dentine bridge formation and it is dependent on odontoblasts, the time passed after pulp capping procedure, the presence of dentine chips etc.

The literature shows there are different methods of approach and pulp capping agents that might be applied for a precise pulp capping procedure.

1. It is well known that the material used as a pulp capping agent is predominantly calcium hydroxide. It is usually applied over the pulp communication as a cement and after its placement the tooth should be filled with a proper restorative material. Calcium hydroxide is applied as an indirect pulp capping material also. This material has a very high pH level which is the main reason for its antibacterial activity. Calcium hydroxide also activates the alkaline phosphatase, thickens the blood vessel walls, supports the remineralisation process of the demineralised dental hard tissue, decreases the inflammation, stimulates the formation of atubular dentine bridge, and is important for creating a pulp communication closure. There are some data that a heterogenic reparative mineralized structure might be formed and there might be included some pulpal remnants. In spite of the mentioned pharmacodynamics it is now considered that the reason for stimulating hard tissue repair is the capability of this material to liberate growth factors incorporated in the dentine extracellular matrix (30). Anyway, the dentine bridge is not always a continuous, dense barrier. There might be a lot of tunnel defects (19). This is the reason for bacterial leakage and pulp tissue incorporation in the cavity. The bacterial leakage might lead to pulp inflammation and calcium dystrophy changes. This could be a reason for direct pulp-capping failure.

2. Another popular material used nowadays is mineral trioxide aggregate (MTA). Its application is multifarious- for direct pulp capping, for filling root canal perforations, for apexitication, and in apical resection cases. MTA is a bioactive silicate based cement. Its’ particle size is small and its sealing ability is very good. MTA has an alkalizing effect and releases calcium ions very slowly (3). MTA stimulates pulp proliferation, cytokine release and hard tissue repair. MTA has a high tensile strength and also stimulates growth factors release that is of a great value for dentine bridge formation. MTA assures a better barrier against bacteria and compared to the calcium hydroxide it is not resorbable (2). The percentage of calcification and root canal obliteration is lower. Some authors report 90% success.

3. Another interesting and new material is the enamel extracellular matrix. It is associated with important biological functions in tooth development (37) and it is applied successfully in dentistry (during treatment of bony defects in patients with advanced periodontitis(7), (8), (4)) as an enamel matrix derivative (EMD) for stimulating cementogenesis in regenerating the periodontal ligament, cement and alveolar bone (23). EMD is created from pig’s tooth bud. EMD contains amelogenin and amelin-enriched fraction and it is in the market presented in gel form where the vehicle is propylene glycol alginate (Emdogain; Biora, Malmo, Sweden). Amelogenin and amelin are structural proteins in the enamel matrix and they have a pivotal role in enamel formation (9). EMD has the potential for inducing regenerative response in the periodontal ligament cells (9). It is applied also in the cases of dental reimplantation (16) and as a direct pulp-capping material in animal teeth (22), (31), (11) and human permanent teeth (24). It can be used also as a capping agent following pulpotomy in deciduous teeth and this shows successful clinical and histological results. It is demonstrated that
EMD induces dentine-like tissue formation when it is used as a pulp-capping agent in permanent molars in old pigs (2). The enamel matrix derivative has the potential to induce regeneration process and there is odontoblast differentiation followed by dentin formation, healing of the pulpal exposure without affecting the normal function of the left pulp tissue which is similar to the natural dentinogenesis (23), (25); It is also considered that the enamel matrix proteins participate in ectodermal-mesenchyme signalization which controls this process (7). As an addition EMD stimulates the odontoblast cells and the endothelial cells of the pulp blood vessels to produce a hard tissue barrier over the pulpal exposure (24). This biomaterial is clinically tested and the amelogenine and amelien are recognized as “autoproteins” by the human immune system. That is why no allergic responses have been reported when this material has been used (4), (33).

Some investigations were made for bioactive amelogenines like A+4 and A-4 (6). They can increase the proliferation of some pulp cells- specifically those that have osteoblast-like progenitory phenotype. After their application a reparative process is induced. After a determined amount of time after placing A+4, a reparative dentine bridge can be noticed. Placing the A-4 stimulates a diffuse pulp mineralization which involves the coronal and root part of the pulp (14).

4. In the science of dental materials the principles of molecular biology, tissue engineering and many other scientific fields are often applied. Regenerative endodontics (pulp regeneration in particular) is a scientific approach that is often applied in the tissue engineering (21), (28), (32). This might include placing of growth factors for revascularization, stem cells or carriers for pulp tissue regeneration (22), (30), (32).

Nowadays, there are many possibilities and a great amount of materials that can be applied as pulp-capping agents. Scientists rely on stimulated but controlled dentinogenesis at the same time which will support tertiary dentine formation that heals pulpal exposure without inducing root canal obliteration. That is why there are more investigations that use growth factors, stem cells, and many other bioactive molecules that might lead to regeneration of the dentine-pulp complex.

4.1. Placement of growth factors is a new approach in saving pulp vitality. Different scaffold can be used for this purpose. Growth factors are still tested predominantly in animals’ teeth. The aim is the same- stimulating dentinogenesis, dentine bridge formation and saving pulp vitality.

Insuline-like growth factors have the potential for clinical application. They have one polypeptide chain and they can make connections with receptors on the cell surface. The reason for their use in direct pulp capping is their ability to affect the cells that are responsible for hard tissue formation (17).

Successful results in pulp capping procedures are reported with the use of some proteins that belong to the superfamily of transforming growth factors (Transforming Growth Factor β, TGFβ) (29) and Bone Morphogenic Proteins-BMPs). BMP can induce collagen type I formation and takes part in the regulation of the cell proliferation and migration and in the extracellular matrix formation. These proteins can be found in the odontoblasts, ameloblasts and in the dentine matrix. They can stimulate the differentiation of undifferentiated pulp cells into odontoblast-like cells. The bioactive molecules from the BMPs group function as signal molecules in the hard tissue repair and have osteoinductive abilities. For successful treatment with the use of BMPs it is important to use a proper scaffold. The same is true for OP-1 or BMP-7. This scaffold should allow gradual release of the bioactive proteins, biodegradation and biocompatibility. Some investigations report full dentine bridge formation can be seen on the third week after the pulp capping procedure. A small amount of osteodentine formation can be evident soon
after BMP placement when there is still some inflammation (13).

Another important issue should be considered and it is with regard to bleeding control- the control of pulp haemorrhagia. Many authors offer different methods for making an accurate bleeding control. For this purpose saline (with a proper temperature) can be used, as well as hydrogen peroxide 30%, hypochlorite 2% or higher, chlorehexidine 1-2%, etc. The scaffolds can be different also. Their structure can be organic or nonorganic. Some of them might have an additional influence on the pulp healing process. They can be collagen-based, nonorganic membranes, titanium, phosphates etc. That is why different investigations might present different results in spite of testing the same bioactive molecules.

The effect of the growth factors toward cell cultures can be observed in vitro. The main purpose is to examine the mechanism of cell proliferation and differentiation that might lead to proper control of these processes. That is why there is a great interest in stem cells. Stem cells can be embryonic and nonembryonic that are placed in already developed tissues and organs. Similar stem cells (20) can be found in the dental pulp, but they are placed diffusely in a small quantity which makes the process of their isolation very difficult. The aim is a regulation of the gene expression of these cells that will transform them into specialized cells that will be able to produce dental pulp substances, that are involved in the tissue repair and dentinogenesis.

5. Calcium-phosphate ceramics are also a kind of material that can be applied as a pulp-capping agent. For example- granulated hydroxyapatite, beta- tricalcium phosphate used as grafting material (35), and alfa- tricalcium phosphate- which is a compound of different cements. These materials can be transformed into hydroxyapatite in the presence of organic acids solutions. Pulpal response toward tetracalcium phosphate containing cements has been investigated. The results show the absence of tissue necrosis but the presence of cell degeneration. It is accepted that the reason for absence of necrosis is the low acidity of these cements and the reason for the cell degeneration is the pressure of the placed material. Unfortunately, the exact mechanisms of dental hard tissue and bone tissue formation are not clear yet. But the opinion is well accepted that the biocompatibility and osteoinductive properties of these cements are at a great importance for that. Maybe the lack of tissue necrosis is the advantage of the tetracalcium phosphate among the other cements (36).

6. Adhesive systems also have the potential for successful pulp capping. They are biocompatiable, they are important for the retention of the filling material, have the ability to reduce microleakage, and have a good sealing ability. But in spite of their positive characteristics their ability to induce healing after pulp capping is controversial. The application of these systems causes dilatation of the pulp blood vessels, congestion, inflammation and pulp abscess formation (18). But maybe the most noticeable thing is the lack of dentine bridge formation (27). During the pulp capping procedure the polymerization of the adhesive system is not complete because of the oxygen and the exudate. So, there are unpolymerized monomers left that reach the pulp tissue and are toxic for the cells. This causes cellular apoptosis. Some authors present data based on clinical investigations that assume the pulp capping as successful if there is lack of pain, the tooth is calm and has its function complete. But there is still a doubt as to asymptomatic pulpal necrosis that is a result of bacterial leakage (15). Unfortunately, this necrosis cannot be observed because there are no histology results. Anyway, the application of the adhesive systems as a pulp-capping material is controversial.

The facts mentioned above, show that the materials and methods of approach for the pulp capping procedure are numerous and widely
varied. This is evidence that the problems regarding the pulp capping are not clear yet. But enamel matrix derivatives, calcium-phosphate ceramics, and growth factors have a potential for future use in the dentinogenesis. There are a lot of investigations reported in the literature.

Direct pulp capping investigations are designed in a different way. Some of them are based on in vitro testing of dental organ cultures for a short term. Maybe the most evidence-based are the investigations that were made with the use of experimental animals. The reason for that is the possibility for long term assessment and the feature of the process of regeneration-interaction between immune response, and hormonal control. Making these interactions in vitro is impossible, which is the reason for using experimental animals. They can be dogs, monkeys, rats or rabbits. The latter two have a specific regenerating capacity and they are proper for making observations of the differentiation of the pulp progenitor cells.

The most common experimental protocol includes creation of a pulp communication and placing a pulp-capping material over it.

The literature data regarding this problem are myriad. The results that come following in vivo and in vitro investigations show this problem is still actual and interesting and there are many future perspectives.

References
1. Инджов. Б., Obturatio Cavi Dentis, 2009, Печат СД “Богомилово”
19. Murray Peter E., PhD and Garcia- Godoy Franklin,
27. da Silva, Lea A. B.DDS, MSc, PhD, de FreitasAldevina C, DDS, MSc, PhD, Nelson-Filho, Paulo, DDS, MSc, PhD and Porto-Neto, Sitenando T., DSS, MSc, PhD, Pretto, Riberao and Araraquara, Brazil, Direct Pulp Capping with a Self-etching Adhesive System: Histopathologic Evaluation in Dog’s Teeth, Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2009;108:e34-e40

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Comparative review of the role and functions of intra-articular fibrous cartilage formations in joints and connections of the human body

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Summary

The aim of the presented review is to make a comparative examination of the role and function of intra-articular fibrous cartilage formations in connections and joints of the human body. While in cartilage connections discs are shock-absorbers, determined to possess low mobility and stability, in the interrupted connections the central role of intra-articular formations is to provide congruence to take the load and to split fully or partly the articular cavity. Emphasis has been placed upon the specific function of „discus articularis” in the mandibular joint and on its involvement in the biomechanics of the joint.

Key words: connections and joints, articularis, articulatio temporomandibularis

Most of the movable joints in the human body have congruent joint surfaces of the bones involved (2, 3, 5, 7). In certain joints however the present discrepancies have been eliminated by means of intra-articular fibro-cartilaginous structures – joint plates (disci articulares), semilunar plates (menisci articulares) or fibrous rings (labrum) (2, 5, 7, 9, 13, 34). These intra-articular structures contribute to the functional improvement and mechanical stability of the joints (1, 4, 21).

Joint plates take part into the formation of certain immovable and partially immovable joints through hyaline and fibrous cartilage (symphysis). For example fibro-cartilaginous plates are present between the vertebrae bodies (symphyses intervertebrales), pubic symphysis (symphysis pubica) and in the junction between manubrium and body of sternum (symphysis manubriosternalis) (2, 3, 7, 9).

Fibro-cartilaginous plates in pubic symphysis and in manubriosternal symphysis are almost static. Pubic symphysis is practically static and only during pregnancy is lengthening partially. Interpubic disc is connected with the homonymous joint surfaces of the pubic bones (facies symphysialis os pubis) (2, 3, 8, 9) and makes a slight movement at the time of birth (18).

Manubriosternal symphysis is a cartilage junction located between the handle (manubrium sterni) and body (corpus sterni) of chest bone (2, 3, 4, 9). The slight movement in this joint at a young age takes place through the fibrocartilage (3), which ossifies in adults.

In intervertebral symphyses the intervertebral discs (disci intervertebrales) are made of core rich in proteoglycans (nucleus pulposus-NP) (35, 37), surrounded by fibro-cartilaginous ring (anelus fibrosus-AF), and between this ring and the adjacent vertebral bodies are located cartilage end plates of hyaline cartilage (cartilage end plates-CEP) (6). These structures undergo changes related to growth and human development (6, 25, 26, 27, 28, 29, 30, 31).
Intervertebral symphyses are partially immovable joints and allow simple, straight motions with limited range (18, 17), in which the intervertebral discs change their shape to some extent (3). Intervertebral discs have a hardness of cartilage and tendon strength and functional use of these connections is shock-absorbers – to cushion the loads (23, 35, 37). With aging this feature weakens (25, 26, 27, 29, 30, 36).

Apart from the listed immovable joints, intra-articular discs and semilunar plates are available in some movable joints (juncturae synoviales s. diarthroses) in the human body. For example in knee joint (articulatio genus) the fibro-cartilaginous menisci correct the proximal joint surface of the tibia and compensate the curvature discrepancy in relation to both femoral condyles (condyli femoris) (2, 3, 4, 8). In addition to providing congruence between the articular surfaces, lateral and medial menisci serve as shock-absorbers. They are movable, so they assume not just forces of pressure, but also a glide. Around the transverse axis in the knee joint, a flexion and an extension takes place accompanied by a small relevant internal and external rotation in flexed limb (3). During the joint function articular menisci are not determinant or limitation of joint movement. It should be noted that the semilunar plates are attached laterally to the joint capsule and spread freely in joint space forming incomplete separation of the joint /unlike the articular discs in the temporomandibular joint-TMJ (articulatio temporomandibularis)/.

The movable joints in human body which have articular discs and imitate to some extent temporomandibular articulation are the sternoclavicular joint (articulatio sternoclavicularis) and radio-carpal joint (articulatio radiocarpalis) (6). There the joint plates knit together with the joint capsules and completely isolate the articular surfaces from one another by dividing the cavity into two chambers. The main purpose of fibro-cartilaginous discs in sternoclavicular joint and in radio-carpal joint is not only to bear major mechanical loads but mainly to contribute to improving the congruency in joints by adjusting the discrepancy in the form of joint surfaces (2, 3, 7, 8).

In sternoclavicular joint the articular disc ensures congruence between the two joint surfaces in the medial part of the clavicle and sternal manubrium (2, 3, 7). Its periphery is united with the joint capsule and therefore the joint cavity is divided into two chambers - sternal and clavicular. Like the TMJ, where normally the posterior third of the articular disc is thicker and up to 3 mm, in sternoclavicular joint it is thickest in the upper-rear, where the load is greatest (6). This joint is a biaxial double sliding diarthrosis (18) with two degrees of freedom of movement: elevation and depression, flexion and extension, and combined movements.

Radio-carpal joint (RCJ) is situated between the distal end of the radius and the proximal row of carpal bones (ossa carpi). The cartilaginous plate (cartilago triangularis) takes place into the formation of this joint with the distal joint surfaces of radius and ulna (facies articularis carpea radii and intra-articular disc) (2, 3, 7, 10). The last one isolates the ulnar bone out of articulation with the wrist bones. The joint capsule is attached to the edges of joint surfaces and cartilaginous plate that is fused with the periphery of the disc so that the joint cavity is separated from distal radioulnar articulation (6). The role of triangular cartilage in the synovial joint is to make the distal surface of the ulna congruent to the proximal articular surface of the proximal wrist bones. Movements in distal radioulnar joint are associated with pronation and supination of the forearm and hand. Ligaments and muscles restrict the rotation in RCJ to combined movements between two axes, namely flexion-extension, abduction-adduction, as well as combined movements.

Although TMJ is synovial, that belongs to a group of movable joints, it has many features (both anatomically and in terms of function)
that determines its uniqueness compared to the other joints in human body (5, 10, 12, 38). Its articular surfaces - head of the mandible (caput mandibulae); articular fossa of the temporal bone (fossa mandibularis) the articular eminence located in front of it (tuberculum articulare) are covered with fibrocartilage (8). Between joint head and articular fossa it is situated fibrocartilaginous plate (discus articularis), which provides congruency in the joint morphologically dividing it into two cavities, possesses buffer function with respect to joint pressure and actively participates in its mechanics (5, 17, 19, 21, 33). According to Okeson (32) structurally and functionally TMJ can be divided into two separate systems, where articular disc plays an important role. One of the joint systems / the complex head of mandibule- articular disc (HM-AD) / is responsible for the rotational movements in the joint. The other joint system consists of the same complex, which functions against the articular fossa.

The movement, which carries out articular disc in the joint system HM-AD, is rotation against the articular surface of the articulation head (32). This is the only physiological movement possible between these two surfaces. The amount of this rotation is limited by the length of the discal ligaments and is determined by its morphology, the degree of intra-articular pressure; also from upper head of lateral pterygoid muscle and upper retrodiscal plate.

In the other joint system free sliding movements are available. Translation occurs in the upper chamber between the complex HM-AD and mandibular fossa. Articular disc participates in movements in both joint systems, so Okeson (32) considers it as a movable joint surface and describes it as „non-ossified bone“.

According to several authors (14, 15, 16, 17, 21, 22, 38) the morphology of the articular disc is very important for maintaining its proper position during function and stability of the joint. The self positioning feature of “discus articularis” is expressed as follows: Biconcave shape facilitates its centering under the action of intra-articular pressure on head of mandible. Lateral and medial discal ligaments support this self-positioning whereas not allowing slippery movements. As a result, in normal disk the articular surface of the joint head rests on the intermediate zone of the disc between the two thick front and rear parts. During the forward translation once again disc morphology and increased intra-articular pressure are the factors that support the head of mandible in the intermediate zone of the disc.

In the mouth closed and at rest in the joint articular disc occupies the foremost rotary position on mandibular condyle, which communicates with its intermediate and rear area. Responsible for this act are the lower intra-articular pressure and constant light tonus of upper head of lateral pterygoid muscle, exceeding the posterior elastic retraction force of superior lamina.

Based on the analysis of immovable, partially immovable and movable joints containing intra-articular, fibro-cartilaginous structures in human body the following conclusions can be summarized:

1. While in immovable and partially immovable joints the main function of fibro-cartilaginous plates is as shock-absorbers that determine poor mobility and increased stability, in movable joints the main role of the articular disc is to provide congruence to assume the load, and to divide the joint cavity into two chambers between articular surfaces.

2. The TMJ has no analogue in a human body. The role of articular disc in it is specific and consists of its participation in mechanics of the joint. It functions as an articulation surface in both joint systems and that precisely corresponds to its name „articular disc“ - „discus articularis“ motivate Okeson (32) to characterize it as a „really complex joint“.

3. An important condition for the implementation of normal function of TMJ is the normal morphology of the articular disc. If
it is significantly harmed its ligament attachment begins to affect the joint function, the joint biomechanics is damaged and dysfunctional symptoms appear.

References

1. Анастасов, К.. Хирургична стоматология, II издание, Мед. и физкултура, 1979, София, 339
2. Ванков, В., Г. Гълъбов. Анатомия на човека. Трето издание, София, Медицина и физкултура, 1990, 89-90
4. Гълъбов, Г., В. Ванков. Анатомия на човека. София, Медицина и физкултура, 1982, 91-96, 104
5. Койчев, К.. Анатомия на човека, I част, София, Медицина и физкултура, 1995, 109, 193, 202, 203
6. Ланджов, Бойчо Василев. Възрастови промени в структурата на човешките междупрешленови дискове и връзката им с дегенеративните заболявания. Дисертационен труд, София, 2008, 61-62, 72, 67-69
7. Топографска анатомия. Учебник за студенти по медицина и дентална медицина. София, Медицинско издателство АРСО, 2010
8. Полихронах, Н. Учебник по пропедевтика на стоматологичната и лицево-челюстна хирургия. София, 1999, 152
10. Угринов, Р., Лицево-челюстна и орална хирургия. Пропедевтика и клиника, София, Печатна база “Киви”, 2006, 312
12. Чучков, Хр., В. Овчаров, Н. Стойнов. Клинична анотомия, София, медицина и физкултура, 1995

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