16th Congress of the Balkan Stomatological Society
April, 2011, Bucharest, Romania

BALKAN STOMATOLOGICAL SOCIETY
&
ROMANIAN DELEGATION OF THE BaSS

Invite you cordially to Bucharest on the occasion of the
16th Congress of the Balkan Stomatological Society
April, 2011

President of the Congress         Prof. Norina Forna

Dear colleagues and friends,

On behalf of the Local Organizing Committee, it gives me great pleasure to invite you for the 16th Balkan Stomatological Society Congress (BaSS) to be held in Bucharest, Romania, in April 2011. This event will be organized by the Romania delegation of the BaSS with the support of the Romanian Society of Oral Rehabilitation (ASSRO), The Romania Dental Council (CMDR) and Romanian Association of Oral Implantology and Biomaterials (SRIOB), under the theme “Update in dental medicine”.

The success of the Annual Bass Congress underlines the crucial role of the scientific programme’s quality. In recent years we have not only seen an increase in the number of participants but also the growth and development of what is now an outstanding scientific programme with continuing efforts to elevate Balkan stomatology to a higher level. This certainly could not have been achieved without your valuable support at the BASS congresses and for that we are extremely grateful.

As the Local Organizing Committee, we hope that, in addition to intellectual and professional growth, we can also provide you with a relaxing and enjoyable social experience. The capital of Romania is an attractive tourist destination, which offers the opportunity to all of you to pay a visit to the numerous historical sites and enjoy the extraordinary Romanian scenery.

We look forward to seeing you all in Bucharest.

Kind regards

Professor Norina Forna
President of the Congress

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Ganglion Cyst of the Temporomandibular Joint: A Case Report 93
SUMMARY

Temporomandibular disorders (TMD) affect more than 5% of the general population. Radiologic investigation of the temporomandibular joints (TMJ) and surrounding tissues offer information adding to the clinical examination, and establishing the final diagnosis. Plain radiographs are helpful as screening tools for the evaluation of bony surfaces of the TMJs. Transcranial, transpharyngeal and transmaxillary projections are used sometimes in combination. Orthopantomography or panoramic radiography is limited in functional disorders, such as hypermobility and recurrent dislocation of condyles. Tomography generates slices of the area of interest but the development of more modern imaging modalities has practically reduced its utilization. Arthrography is an invasive procedure that shows indirectly the position and the shape of the disc, as well as disc perforations or adhesions to the fossa. Computerized tomography offers advanced capabilities of imaging the hard tissues. Advancement of the equipment with cone beam CT further enhanced its diagnostic value for arthritides. Magnetic resonance imaging reproduces in detail the disc and soft tissues and provides acceptable imaging of the bone surfaces. Improvements in the technique, by using paramagnetic contrast medium intravenously or intraarticularly, render MRI the current golden standard in TMJ imaging. Ultrasound is a radiation free, non invasive and repeatable technique, recently proposed for use in TMD. Other examinations such as scintigraphy or single photon emission tomography have specific indications and restricted use in TMJ diagnostics. Finally, among the various techniques the clinician must choose the most appropriate to the kind of information needed.

Keywords: Temporomandibular Disorders, diagnostics; Temporomandibular Joint, imaging

Introduction

Temporomandibular disorders (TMD) represent one of the most common dysfunctions, affecting a large segment of population. In developed countries, more than 5% seek medical help for symptoms related to the masticatory system. Prompt clinical diagnosis is the fundamental step towards effective treatment, although staging and classification of TMD may differ among clinicians. A radiologic examination of the temporomandibular joint (TMJ) gives the clinician the opportunity to: (a) support the clinical diagnosis and proceed to a differential diagnosis; (b) obtain new information, depending on the selected examination modality; (c) adapt the information to the clinical diagnosis and vice versa; and (d) develop the necessary skills that will enable him to choose the most appropriate and cost-effective solution for each case.

In the present study, 6 main radiologic examinations are compared with respect to their indications, limitations, and cost: plain radiography (transcranial, transpharyngeal, and transmaxillary projections), orthopantomography and its variants, arthrography, conventional as well as computerized tomography (CT) with emphasis on novel technology such as cone beam CT, magnetic resonance imaging (MM), and, finally, magnetic resonance arthrography. Other, specifically used diagnostic modalities, such as ultrasonography and scintigraphy, are also discussed.
Description of Radiologic Techniques

Plain Film Radiography

The term “plain” refers to radiographs made with a stationary x-ray source and film, or with a digital receptor. Radiographs of the TMJ in 1 plane are the simplest, fastest and easiest way to obtain certain information on TMJ hard tissues. To get valid information on joint structures, at least 2 different views in perpendicular projections are necessary.

Lateral Oblique Transcranial Projection (Schuller) directs the x-ray beam in a manner that is approximately parallel to the long axis of the condyle. The 15 to 25 degree angle between the beam and the horizontal plane, described as “positive” when beam is directed from a point above the TMJ, and focused down on the examined joint, reveals the lateral aspect of the joint. The central and medial portions of the joint are projected downwards, superimposed on the rest of the condylar process.

The transcranial view can be used to examine the TMJ for gross arthritic changes, particularly in the lateral part of the joint, but may not reveal subtle osseous changes and will not display the disc. An overall estimation of the space between osseous elements is also possible with this view (Fig. 1).

In the transpharyngeal projection, the x-ray beam is projected to the TMJ through the mandibular sigmoid notch of the opposite side in front of, and below the joint. The mouth must be opened to avoid superimposition of neighbouring structures, and the film is placed parallel to the sagittal plane of the head. This projection yields a lateral view of the condylar head and neck, and of its articular surface.

This view is effective for visualizing destructive changes, but less valuable in visualizing productive changes. Information on the temporal component of the joint cannot be obtained with this modality (Fig. 2).

Orthopantomography

Panoramic radiograph (PR) is the technique of choice in general dental practice, and provides adequate screening images of the TMJ, mandible, maxilla, teeth and surrounding hard tissues. The effective radiation dose in PRs is low (compared to plain film radiography). Modern machines deliver a radiation dose of approximately 20 mGr (milligrays, 1 gray=100 rad) to the skin surface. With the use of digital equipment, the exposure can be reduced by about 43% with no loss image quality. Some panoramic machines utilize special TMJ techniques that permit placement of opened and closed views of both condyles on a single film.

Generally, images with the mouth both closed and opened are mandatory in the diagnosis of hypermobility and recurrent dislocation of the condyle. Panoramic images may show only extensive erosions and large osteophytes in the TMJs. Attempts have been made to identify internal derangement of the TMJs from...
panoramic radiographs; however, it is reminded that this is a radiographic technique, thus no information is available about soft tissue elements. Occasionally, the clinician can identify patients with potential internal derangements of the TMJ, but distortion effects may disturb image quality (Fig. 3).

In conclusion, PR can give a general impression of the joint in 2 dimensions, but it is less sensitive in evaluating changes in condyles, its reliability is poor, and its accuracy in evaluating temporal components of the joint is low; thus its value for TMJ diagnostic purposes is questionable.

Disadvantages of arthrography include its invasive nature, the risk of placing the needle outside the joint space, possible allergic reactions to the contrast material, and significant exposure of the patient to radiation. The advent of MRI has contributed to a decrease in the number of arthrographies performed over the last years, but in certain cases e.g. when there is a suspicion of perforations or adhesions, the use of the technique is still indicated.

In arthrography a non-ionic, water-soluble radiopaque contrast material (usually a derivative of iodine) is injected into either the lower or upper joint space, or into both compartments, sometimes under fluoroscopic guidance. The upper compartment is the one most frequently used. In double-contrast arthrography, a small amount of air is injected into the joint space after the injection of the contrast material. Comparative studies have not proven any statistically significant difference in accuracy between these 2 methods of projection.

Arthrography is indicated for evaluation of the location, shape, and movement of the disc, through observation of shape and flow of the contrast material within the articular compartment, as the patient opens and closes the mouth. Perforations of the disc can be determined by flow of the contrast medium from one space after injection into the other; capsular tears and disc adhesions can also be visualised by the same indirect observation of the shape of the medium. If video-fluoroscopy is used, the movement of the disc during function can be recorded.

Computerized Tomography

In computerized tomography (CT), thin sections of the structures of interest can be made in several planes. This imaging technique eliminates blurring of structures located outside the image layer, an inherent shortcoming of conventional tomography, and also overcomes the problem of distortion and superimposition encountered in plain film radiography (Fig. 4). CT can also provide 3-dimensional images through a reconstruction of the original data (Fig. 5).

According to a position paper of the American Academy of Oral and Maxillofacial Radiology published in 1997, CT is mainly suited for the diagnosis of bony abnormalities including fractures, dislocations, osteophytes, arthritides, ankylosis, and neoplasia. However, diagnosis of disc displacement cannot be ascertained through CT, although “some promise for CT in the detection of internal derangement” has been recognized.

New generation cone beam CTs (CBCT) utilize less expensive equipment, and expose the patient to approximately 20% of the radiation of helical CT.
Designation of this equipment is not based on the concept of sectional images but in computer processing of a single rotational scanning of the region of interest. CBCT has specialized imaging capabilities for assessing osteoarthritic changes in detail, and for accurately calculating joint space. It is increasingly used for investigation of TMD because of its operability; another advantage of it is the short examination time which is of importance when a study of both TMJs with open and closed mouth is to be performed.

However, diagnostic quality can vary widely between institutions, depending on the expertise of the technologists, radiologists interpreting the findings of the examination, on the field strength of the magnet, as well as on the quality of surface coils and software of the MR imager itself. Many reports deal with the improvement of the diagnostic sensitivity of MRI, which is achieved by reconstructing images on video, thus enabling a dynamic TMJ display according to some, or by using an intravenously administered paramagnetic contrast medium, a technique referred to as “contrast enhanced” MRI of the joint, according to others. Research has upgraded the value of MRI as a diagnostic tool, but the presence of perforations and adhesions can still be only indirectly inferred through MRI. Furthermore, supporters of arthrography, as well as the American Academy of Oral and Maxillofacial Radiology, state that disc perforations and capsular tears are more successfully detected through arthrography.

Figure 4. Coronal CT shows severe osteoarthritic changes in the left and mild in the right TMJ

Figure 5. 3D reconstruction of a CBCT with open mouth reveals a recurrent dislocation of the left condyle, whilst provides information the osteoarthritic surfaces of the condyle and fossa (arrows)

Figure 6. MRI of the left TMJ with open mouth in a patient with the anteriorly displaced disc shows clearly reduction of the condyle

In a paper published in 2000, a new technique of obtaining MR images of the TMJ was proposed, by means of injecting a paramagnetic contrast medium into 1 or both joint spaces (Fig. 7). According to prior developments in orthopedics, the technique is called “MR arthrography”, but there is no sufficient data to establish its validity, accuracy, and sensitivity, when compared with classic MRI.

Magnetic Resonance Imaging

MRI is an imaging technique in which not only bone, but also soft tissue structures can be reproduced in detail through the use of static and dynamic magnetic fields. MRI utilizes no radiation, and therefore has no harmful biological effects; the procedure is characterized as the gold standard for imaging internal derangement of the TMJ. MRI utilizes no radiation, and therefore has no harmful biological effects; the procedure is characterized as the gold standard for imaging internal derangement of

Ultrasonography (US)

TMJ ultrasonography is a non-invasive, readily available, and relatively inexpensive, as well as dynamic “real time” examination. The transducer is placed on the skin above the joint, almost parallel to the long axis of the mandibular ramus. When used at a frequency of 7.5-12
MHz, it may depict the condyle and articular eminence, the narrow space of the joint, and the position of the disc (Fig. 8). High resolution US machines are sensitive in detecting the absence of internal derangement, and reliable in predicting the presence of it.

The most significant advantage of this biologically harmless examination is that allows for a close follow-up of the patient after any treatment applied for TMD. US is a promising modality but its sensitivity, accuracy and positive predictive value will have to be improved in the future, through the use of higher-resolution equipment34.

Other Imaging Modalities

Nuclear medicine procedures are of specific value with respect to developmental or inflammatory disorders of the TMJ.

Scintigraphy is recommended when the activity of the augmentative centre of the condyle has to be assessed (condylar hyperplasia or avascular necrosis of the condyle). Radionuclide 99mTc is utilized in this examination. Single photon emission tomography (SPECT) is reported to give sensitive information on inflammatory conditions such as arthritides, but its specificity is low, thus its use is limited.

Discussion

TMJ imaging does not supplant clinical diagnosis, but it does complement it. The clinicians might make a selection among the various imaging modalities based on the criterion of the type of information needed in order to support or dispute their initial clinical diagnosis15. Moreover, sometimes their choice is limited (by economic or other issues) to the most appropriate modality among the ones that are available to them. A common error on the part of clinicians regarding the selection of the modality to be employed is that they resort to PR for first draft imaging of the TMJ, when by doing so they run the risk of obtaining false positive results. A possible cause of this practice could be both the clinicians’ and the radiologic technicians’ lack of familiarity with static projections. It is more informative to use terms for plain radiographs that describe the position of the beam and the film or, at least, a term as descriptive as possible i.e. occipito-mental instead of Water’s, or transcranial instead of Schuller.

The clinical diagnosis of masseteric myalgia usually does not require any radiologic confirmation. If, however, it has to be distinguished from arthralgia or the first degree disc displacement with reduction (DWR), the ideal delineation of the diagnosis should be done by US, which gives information on intra-articular presence of liquid (arthralgia), absence of DWR, and masseteric hypertrophy (masseteric myalgia - bruxism). But US is an examiner-dependent examination, and there is not enough experience in its use as a TMJ imaging modality yet. Plain radiography and CT scan are of no use whatsoever in this case. MRI will show the position of the disc, and probably also a hypertrophy of the masticatory muscles. It has to be kept in mind that MRI-indicated disc displacement does not always match the clinical diagnosis, or the symptoms described by the patient. Overall, the group of myofascial pain disorders requires prompt clinical diagnosis, while imaging of the TMJ should be reserved for cases where a clinical suspicion of internal derangement or degenerative change has to be examined.
Disc displacement, with or without reduction, can be radiologically confirmed by either MRI or arthrography. At the moment, US is only valid when it yields negative results (absence of disc displacement). In addition to displacement, MRI may also show disc deformation which is predictive, not evidential, for the integrity of the disc. In cases of chronic and painful disc displacement that is resistant to conservative treatment and indicative for surgery as a treatment option, more specific investigation of disc integrity is needed in order to draw up an accurate treatment plan. To this end, an invasive examination such as arthroscopy, arthrography or MR arthrography is appropriate. The latter is regarded as the preferred method, because it is less invasive than arthroscopy, and in all probability less likely to result in complications such as allergic reactions than conventional arthrography. Moreover, MR arthrography yields comprehensive information on the position of the disc and the existence of adhesions, and can be regarded as the optimal imaging modality for the group of disc displacement.

Osteoarthrosis and arthritides represent a separate entity of TMD in almost all staging and classification systems. Their difference, when compared with the group of simple disc displacement, lies in the more progressive nature of disc degeneration on the one hand, and in the presence of osseous lesions on the condylar bone surface on the other. Plain radiographs, especially transcranial projections, are sufficient to depict bone lesions. CT scan and cone beam CT give a more detailed picture of the condyle, and 3D reconstruction is able to offer a comprehensive simulation of the operative field, when “shaving” of the condyle is planned. The radiation dose is higher in CT modalities than in plain radiography, but in cone beam CT it is significantly lower. However, the primary concern when surgical intervention is decided upon for treatment of osteoarthritic cases is management of the disc. None of the above-mentioned imaging modalities are sufficiently informative on disc status. MRI and MR arthrography are, as has already been noted, the examinations of choice for the investigation of disc position and composition, but are inferior to CT in the depiction of osteoarthritic lesions. Some authors may argue whether CT is preferable to MRI for pre-surgical evaluation of osteoarthrosis, although it is considered the imaging modality of choice for osseous changes.

Hypermobility may be considered one of the predisposing factors for internal derangement. Panoramic radiography in both open and closed mouth positions is sufficient for proving condylar dislocation during maximum opening. In later stages, where pain in chewing hard foods is added to the patient’s symptoms, the possibility of disc displacement needs to be more specifically investigated through the use of either MRI or MR arthrography.

References
Evaluation of Different Types of Cement in Full Arch Implant Fixed Partial Prosthesis

SUMMARY

Background: For cement-retained implant prostheses, the retention forces of luting cements are an important criterion when selecting luting cement.

Purpose: To evaluate different types of cement in full arch implant fixed prosthesis to fit on solid titanium abutment.

Material and Methods: An artificial mandible composed of self-polymerizing acrylic resin was made. 8 ITI implant analogs were mounted in the self-polymerizing acrylic resin using a surveyor and placed in centrals, canine, second premolar and molar teeth region for each side. Prefabricated burnout caps were placed on the titanium abutments and wax loops added to the occlusal surface; samples were casted with base metal alloys. 4 permanent and 3 provisional cements were tested in this study. After cementation, samples were subjected to a pullout test using an Instron universal testing machine at a crosshead speed of 0.5 mm/min. Loads required to remove the crowns were recorded and mean values for each group determined. The data were submitted to ANOVA, post hoc least square differences (LSD) and paired specimens test at confidence interval of 95%.

Results: The mean values of loads in Newton at failure for the various cements were as follows: Cavex 83.55 N, Relyx Temp NE 153.4 N, Premier Implant 335.5 N, Adhesor 256.1 N, Adhesor carbofin 401.3 N, Kavitancem 424.6 N. There were statistical significant differences between tensile bond strength values of all the cements (P<0.05).

Conclusions: In the study, the higher bond strength value was found with Kavitancem, the weakest value with Cavex; amongst the provisional cements, the highest bond strength value was found with Premier cement.

Clinical Implications: Retention values of casting to natural teeth versus metallic implants may be very different for the same cement and cannot always be compared. It is clearly recognized that the retentive force mainly depends on the properties of the cement used.

Keywords: Implant Supported Prosthesis; Tensile Bond Strength; Cements

Introduction

In recent years, there has been a remarkable progress in the field of implant dentistry. However, many questions have arisen regarding the materials and techniques used in clinical practice. One of the questions is related to the method by which fixed partial dentures (FPD) are connected to underlying implants: screw retained or cemented? The use of screw retained versus cement-retained implant restorations has been subject of controversy in the literature. Cement-implant-supported restorations (CISR) are routinely used in dentistry. This approach resembles conventional prosthetic procedures. As distinct advantages for the cemented technique, CISR list better aesthetics, passivity of the framework, better occlusion, simplicity of fabrication, and reduced cost of components and construction. Fabrication is easier than that for screw retained prostheses, because traditional prosthetic techniques are followed...
and there is no need for special training of laboratory technicians. Restorations of implants with a divergence of less than 17 degree are also easier with cement-retained restorations.

The greatest disadvantage of CISR technique is lack of reliable means of retaining and then retrieving the superstructure for routine care and maintenance. Retrieval is highly desirable for cleaning and it facilities evaluation for mobility ailing implants. Consequently, the selection of luting agents is very important for CISR. The mechanical properties of luting cements are an important criterion when selecting luting cement. The probability of early tensile failure is reduced with use of stronger cements; hence, the chance of clinical success is increased. Mechanical factors, such as resistance/retention form, height, distribution and number of abutments, accuracy of superstructure fit, as well as maxillary versus mandibular arch, will strongly influence the amount of cement retentiveness required for a given restoration. A number of references that compare the retentiveness of the cements commonly used in this technique are available.

The aim of this study was to evaluate the retentive strengths of dental cements that have been adapted in full arch implant fixed prosthesis. The null hypothesis was that the retentive strengths of dental cements that have been adapted in full arch implant fixed prosthesis would show different results as adapted implant prostheses.

Material and Methods

Test specimens consisted of 1 maxillary acrylic resin model with inserted 8 ITI implants (Institut Straumann AG, Waldenburg, Switzerland) and solid titanium abutments (Fig. 1). The base metal alloy’s (Rexillium III; Pentron Laboratory Technologies, Wallingford, Conn.) cast onto abutments formed an attachment mechanism for testing (Fig. 2). The experimental abutment and test design was previously tested by Mansour at al. Four permanent and 3 provisional cements were tested in this study (Tab. 1).

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<td>2</td>
<td>Adhesor Carbofin (AC)</td>
<td>Zinc polycarboxylate cement</td>
<td>Permanent</td>
<td>Sofa Dental, Czech Rep.</td>
</tr>
<tr>
<td>3</td>
<td>Kavitan cement (KC)</td>
<td>Glass ionomer cement</td>
<td>Permanent</td>
<td>Sofa Dental, Czech Rep.</td>
</tr>
<tr>
<td>4</td>
<td>Multilink (M)</td>
<td>Self cure resin composite cement</td>
<td>Permanent</td>
<td>Ivoclar, Vivadent, Schaan, Liechtenstein</td>
</tr>
<tr>
<td>5</td>
<td>Cavex (C)</td>
<td>Zinc oxide eugenol free</td>
<td>Provisional</td>
<td>Cavex, Haarlem, Holland</td>
</tr>
<tr>
<td>6</td>
<td>Relyx Temp (RT)</td>
<td>Zinc oxide eugenol free</td>
<td>Provisional</td>
<td>3M ESPE, Seefeld, Germany</td>
</tr>
<tr>
<td>7</td>
<td>Premier Implant Cement (PI)</td>
<td>Non-eugenol temporary resin cement for implant retained crowns</td>
<td>Provisional</td>
<td>Premier, Hannover, Germany</td>
</tr>
</tbody>
</table>

Figure 1. Solid titanium abutment 5.5 mm in height was placed on each implant, and torque at 35 Ncm

Figure 2. The upper part of the prostheses was attached to a metal plate composed of chrome-cobalt material
An artificial mandible composed of self-polymerizing acrylic resin resembling edentulous mandible was produced. 8 ITI implants were placed in central incisor, canine, second premolar and second molar regions at both sides using a surveyor according to paralleling criterion in a self-polymerizing acrylic resin. Solid titanium abutment 5.5 mm in height was placed on each implant and torqued at 35 Ncm. The abutment was supplied with a prefabricated burnout caps that snap onto the abutment analogue. This cap is produced to provide a defined cement gap between crown and the abutment, hence eliminating the need for die spacer. A tiny lip on the margin of the cap provided the snap-on mechanism. Then wax loops were added to the occlusal surface of the restorations to allow for subsequent retention testing. The entire superstructure was invested in phosphate-bonded investment (Hi-Temp; Whip Mix Co, Louisville, KY) and casted with Rexillium III base metal alloys in the usual manner. The specimens were then retrieved from the casting rings, the investment materials were cleaned with a steam cleaner (Pro-Craft II Steamer Cleaner; Ivoclar North America, Amherst, NY), and the inner surface of the copings was inspected for surface irregularities with a stereomicroscope (Model BM, 38834; Meiji Techno, Tokyo, Japan) at 10 magnification and adjusted with a #1/2 round carbide bur. Each casting was assigned to implant-abutment assembly, and silicone disclosing medium (Fit Checker; GC Europe, Leuven, Belgium) was used to achieve the best possible fit. Cements were mixed according to manufacturers’ recommendations and applied on the axial surface of castings to minimize hydrostatic pressure during seating. Then, the specimens were cemented on the solid abutments with a load of 5 kg maintained for 10 minutes according to ADA specification No:964. Excess cement was cleaned off using a scaler. Mixing and cementing procedures were carried out at room temperature.

After cementation, implant-abutment-casting assemblies were stored for 24 hours at 37°C in 100% humidity environment. The specimens were then subjected to a pull-out test (tensile test) using universal testing machine (Instron 3345 Tester; Instron Corp, Norwood, MA) at a crosshead speed of 0.5mm/sec, recording the maximum tension value (Fig. 3). Each measurement was repeated 3 times after sufficient time intervals. The components of the specimen were cleaned from cement residues after each tensile test; the residual cement was mechanically removed with a hand instrument. After removing the cement residues, the specimens were cleaned with self-cure acrylic resin solution (Removal-on-1; Premier Dental Products Company, Norristown, PA). Sand blasting, high and low speed air-routers were avoided in the cleaning process of the cement residues to prevent any change in the structure of the castings and the abutments. The load required to de-cement the prosthesis was recorded with Newton standard and mean value was calculated.

Figure 3 (a and b). The specimens were subjected to a pull-out test (tensile test) using universal testing machine at a crosshead speed of 0.5mm/sec.
1 investigator visually inspected each specimen after separation and estimated the percent of the surface of the abutment without cement.

A 1-way ANOVA and a post hoc least square differences LSD test were done at confidence interval of 95%.

## Results

Mean tensile forces required to separate the castings from the abutments, for all cements, are mentioned in table 2. C showed the least retention, and KC provided the highest retention. There were statistical significant differences between tensile bond strength values of all the cements (P<0.0006). Comparison between A, AC, C and RT cement was performed, the statistical significance value was set at P<0.015 (Tab. 2).

### Table 2. Mean cement failure load (N) and result of LSD test

<table>
<thead>
<tr>
<th>Cement type</th>
<th>Mean ± SD</th>
<th>Min.</th>
<th>Max.</th>
<th>LSD test</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>83.55 N ± 29.85</td>
<td>46.1520 N</td>
<td>139.3170 N</td>
<td>A</td>
</tr>
<tr>
<td>RT</td>
<td>153.4 N ± 60.34</td>
<td>59.732 N</td>
<td>221.936 N</td>
<td>A</td>
</tr>
<tr>
<td>PI</td>
<td>335.5 N ± 91.65</td>
<td>177.7980 N</td>
<td>415.9880 N</td>
<td>B</td>
</tr>
<tr>
<td>A</td>
<td>256.1 N ± 51.21</td>
<td>176.8170 N</td>
<td>316.2890 N</td>
<td>C</td>
</tr>
<tr>
<td>AC</td>
<td>401.3 N ± 120.1</td>
<td>262.3670 N</td>
<td>586.8370 N</td>
<td>D</td>
</tr>
<tr>
<td>KC</td>
<td>424.6 N ± 163.1</td>
<td>313.7000 N</td>
<td>655.0980 N</td>
<td>D</td>
</tr>
<tr>
<td>M</td>
<td>**</td>
<td>**</td>
<td>**</td>
<td>**</td>
</tr>
</tbody>
</table>

* Same letter denotes that groups were not significantly different from each other (p>0.05)
** No values were calculated

Among the provisional cements, C showed the least retention, while RT had better results for retention (Tab. 2). PI showed the highest retentive value. Post Hoc Dunn’s multiple comparison tests within the cement subgroups revealed that there were significant differences between C and PI, and between RT and PI (P<0.01 and P<0.05, respectively). There were no significant differences between C and RT (P > 0.05).

Among the permanent cements, KC showed the highest retentive results, and A showed the least. The statistical significance in this group was set at P<0.039. Post Hoc Dunn’s multiple comparison test within this cement group (Tab. 2) revealed significant differences between A and KC, and between A and AC (P<0.05). There were no significant differences between KC and AC (P<0.05).

For all of the cements and all of the test conditions, minimal cement adhered to the abutments after dislodgement. Thus, cement failure was primarily adhesive or at the abutment/cement interface.

## Discussion

In this in vitro study, cement failure was evaluated by using full arch implant fixed prosthesis cemented to 8 implant abutments with 1 of 7 luting protocols using tensile loading. Laboratory technician with easy and predictable procedures provided ITI solid abutment plastic burnout cap system. A space was manufactured between the abutment and the plastic cap, hence eliminating the need for die spacer. The built-in cement space measurement was 20μm, which is consistent with ADA specification NO:96 for ideal cement thickness. The presence of this uniform cement space also decreased the need for casting adjustments.

This study showed that tensile bond strength values of provisional cements, except for PI, were significantly lower than those of permanent cements. Among the permanent cements, glass ionomer cement and zinc polycarboxylate cement exhibited higher tensile bond strength value than zinc phosphate cement. Breeding et al17 compared 3 provisional luting agents, glass ionomer cement and 2 resin luting agents. They found that the 3 provisional cements were less retentive than the glass ionomer and 2 resin luting agents. Pan and Yin9 compared 2 provisional luting agents and 4 definitive cements. They found that the provisional cements were much less retentive than definitive cements. These findings matched the result of the present study, which demonstrated that provisional cements (Cavex and Relyx Temp) were much less retentive than Kavitan Cem glass ionomer cement, Adhesor Carbofine polycarboxilate cement and Adhesor zinc phosphate cement.

Racher et al18 found that resin cement demonstrated the highest mean retentive strength when compared with zinc phosphate cement and resin-reinforced ionomer cement. In this study we also used multilink resin cement. During the test, no values were obtained, the load cell was probably not appropriate, so that this cement might not be suitable for testing in full arch implant fixed prosthesis study design. Our study is also in agreement with other, who showed that the retentive strengths of the provisional cements are lower than those of the definitive cement7,9,12,17. The group of cements tested in this study ranged from common dental cements generally designed for permanent cementation to those considered for provisional cementation, and included some specifically designed for implant restorations6. It should be reasonable to expect that those cements using as permanent luting agents, such as resin cement, glass ionomer cement, polycarboxylate cement and zinc phosphate cement, would be at the top of the retention list.
Mansour et al found that the rank order of retentiveness differed when tested on implants or natural teeth. This was also found to be true in our study. Preconceived expectation generally held true, with the finding that PI cement, which is non-eugenol provisional resin cement for implant retained crowns, showed higher strength bond value than zinc phosphate cement. Thus, the null hypothesis was accepted, that the retentive strengths of dental cements that have been adapted in full arch implant fixed prosthesis would show different results as adapted implant prostheses. Hence, the retentive strength of PI was significantly higher than all cements except Zinc polycarboxylate cement and Glass ionomer cement tested in this study. It was interesting that PI also exhibited a higher tensile bonding strength values than zinc phosphate cement. This could be explained by the fact that zinc phosphate cements provide casting retention by micromechanical interlocking into the casting and the abutment surface irregularities. The high strength of the PI is similar to permanent cements, and might be due to silicon contains, which add to the adhesion strength of the cement. Manufacturer advocated that during the application of PI, lubricant could be applied on the abutments; therefore, it would be easier to retrieve the prosthesis if needed in future. It is not known would PI with the KJ Jelly provide sufficient retention so that the patient would have to return for recommendation at an unexpected time. In general, however, the rank order in this study is in agreement with the rank order of similar studies.

Mansour et al observed that the goal of studies such as these is not to discover the “best” cement. Rather, the goal is to provide “the ranking order of the cements in their ability to retain the casting”. The clinician’s opportunity to select from the retentiveness of various cements and apply it in an escalating fashion allows a sense of comfort and control when releasing the patients after insertion of crown.

This in vitro investigation had several limitations that must be addressed in future studies:

No thermal cycling test and cycling fatigue test was used, so the effects of degradation were not take into account in this study. Therefore, cyclic fatigue stress, thermal cyclic testing should be considered in future studies;

Each abutment/superstructure combination was used 3 times with cleaning and reabrading of the superstructure interior accomplished between each cement sample. This raises the question of consistency of fit being affected by the cleaning process and influencing the data;

Castings in this study were made from a base metal alloy (Rexillium); if a precious metal alloy or some other material had been used, results might be different.

Conclusions

It is clearly recognized that the retentive force mainly depends on the properties of the cement. The use of appropriate cement for a specific restoration type may reduce cement failures. However, the clinical outcome of different cements used for different restorations has not been investigated. The future studies are needed on this subject.

References


Correspondence and request for offprints to:
Professor Yasemin Kulak Ozkan
University of Marmara, Faculty of Dentistry
Güzelbahçe Büyükçiftlik Sok. No.6
34365 Nişantaşı, Istanbul, Turkey
E-mails: yasyas@superonline.com, ykozkan@marmara.edu.tr

SUMMARY
The objective of this study was to assess the effect of heat activation on the surface properties of glass ionomer cements. The effect of heat on glass ionomer cements during their setting was evaluated by scanning electron microscopic (SEM) evaluation. A condensable glass ionomer cement Fuji IX and a ceramic-reinforced glass ionomer cement Amalgomer CR were used as test materials. Heat was applied with soldering iron for 2 minutes at 80±2°C. All of the evaluations were carried out 24 hours after the setting of glass ionomer cements.

Significant differences were found between the control and the heated groups and between Fuji IX and Amalgomer CR. It is established that heat influenced the surface properties of conventional glass ionomer cements.

Keywords: Glass Ionomer Cement; Heat; SEM

Introduction
Glass-ionomers have been always a preferable material in restorative dentistry, providing chemical bond without etching1-3 and fluoride release1,2,4-10. However, the low mechanical strength of the conventional formulations limits its use in high stress sites, such as class I-II restorations10,11. There have been some efforts, such as addition of strong additives like ceramic, pre-cured glass-ionomers12 or resin composites13,14, to improve the strength of glass ionomer. These new materials possess the beneficial characteristics of the conventional glass-ionomers but have some disadvantages, such as polymerization shrinkage or monomer toxicity15.

Heat has been shown to be beneficial to properties of a number of dental materials, particularly of resin composites16. However, a few studies have been carried out with regard to the application of heat to dental cements17. There are some studies on acceleration of setting rate by ultrasound or heat to improve mechanical characteristics of the conventional glass ionomer cements (GICs). The first setting phase of the material occurs within the first 10 minutes after mixing when the material is very sensitive to humidity. The short-term sensitivity to water results in low wear resistance and fast or command setting of the material improves the instant setting of the material without a change in the chemical composition.

Woolford17 investigated the effect of heat activation on GICs and found that raising the temperature of the cement surface to a maximum of 60°C significantly improved the initial surface hardness of the cement. Kleverlaan et al18 investigated the influence of externally applied command set applications on the mechanical properties of several commercially available conventional GICs. In general, all experiments provided an increase in strength respectively from standard curing, ultrasonic curing to heat curing.

Therefore, the purpose of this study was to assess the effect of heat activation on the surface properties of conventional GICs. It was also the subject of this study to analyze the heat transfer degree through the specimens. The hypothesis tested was that the higher degrees of heating may affect the liquid content of the glass ionomer and has important clinical implication on surface characteristics of the restorative materials.

Material and Methods
In the study, Fuji IX (condensable GIC) and Amalgomer CR (ceramic-reinforced GIC) were tested. The information about content of the tested materials is summarized in table 1. 32 GIC surfaces were prepared for the study. The information about study groups is summarized in table 2.
Table 1. The content of the tested materials

<table>
<thead>
<tr>
<th>Product</th>
<th>Manufacturer</th>
<th>Lot</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuji IX</td>
<td>GC, JAPAN</td>
<td>Powder 0411051</td>
<td>Powder: Glass, Polyacrylic acid, Tartaric acid</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Liquid 0411051</td>
<td>Liquid: Polyacrylic acid</td>
</tr>
<tr>
<td>Amalgomer CR</td>
<td>AHL, ENGLAND</td>
<td>Powder 020615-1</td>
<td>Powder: Glass, Polyacrylic acid, Tartaric acid, Zirconium oxide</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Liquid 040522-7</td>
<td>Liquid: Polyacrylic acid, water</td>
</tr>
</tbody>
</table>

Table 2. Study groups

<table>
<thead>
<tr>
<th>Surface</th>
<th>Fuji IX</th>
<th>Fuji IX -heated</th>
<th>Amalgomer</th>
<th>Amalgomer-heated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface 1 mm depth</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Interface 3 mm depth</td>
<td>0</td>
<td>4</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
<td>10</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>

Study was carried out at room temperature (23±1°C) and relative humidity (50±10%) as stated in the ISO Standard 9917-1:2003 (E) for glass polyalkeonate cements. The materials were mixed according to the manufacturer’s instructions and placed in the stainless steel moulds. The moulds were preheated up to 37°C and were kept in the incubator during setting of the cement to represent the oral situation.

Both heat-applied surfaces and inner surfaces were evaluated in heat-applied samples. Specimens that were 10 mm in diameter and 2 mm in depth were prepared for evaluation of surface characteristics for both tested materials with and without heat application. Specimens having a 4 mm diameter and 6 mm depth were prepared for evaluation of inner surfaces of GIC with and without heat application. The surface of the cement was covered with a single cellulose acetate sheet to provide a smooth surface. Stainless steel moulds were placed on the top of the cellulose sheet to give the specimen a flat surface. Fuji varnish was applied to both GICs. After initial setting time, specimens were removed from the incubator and heat was applied with a soldering iron (Lötstation MLS-48, McVoice, Verzeuge, Germany) on 1 surface of the specimens in the study group. The soldering iron was set to 80±2°C and applied for 2 minutes. The active tip of the soldering iron was 10 mm in diameter. Applied heat and temperature rise in the specimens were measured with thermocouple (Thermometer HD 8605, Delta OHM, Italy). The specimens were removed from the stainless steel moulds 1 hour later. The samples were kept in distilled water at 37°C and they were evaluated 24 hours after the initial set point.

6 mm depth specimens that were prepared for evaluation of inner surfaces of GIC were separated into 2 longitudinal pieces by means of a chisel. The interface areas at 6 mm on the heated side of the specimens were examined. In order to observe the effect of heat along the interface area, the points that were situated at 1 mm and 4 mm in depth were examined respectively.

All specimen surfaces that were going to be evaluated with SEM (JEOL JSM 5200 Tokyo, Japan) were sputter-coated with gold and then examined under various magnifications.

Results

Surface Characteristics

While homogeneous structure and numerous cracks were present on the surface of Fuji IX controls (Figs. 1 and 2), heated Fuji IX specimens showed a different surface structure. It had a heterogeneous pattern and there were degradation. Fuji IX heated specimen surfaces showed more cracks than the Fuji IX controls. Fuji IX heated specimens displayed a higher level of porosity and irregular voids as a result of matrix dissolution (Figs. 3 and 4).

Amalgomer CR control specimens presented smooth surfaces (Figs. 5 and 6). There was a difference of surface characteristics among the control and the heated groups. The material appeared to be affected from heat. Well-dispersed particle distribution was observed in heated groups (Figs. 7 and 8).

When compared, Fuji IX controls had more cracks on the surface than Amalgomer CR controls (Figs. 2 and 6).
Figure 1. Fuji IX control (x200)

Figure 2. Fuji IX control (x1000)

Figure 3. Fuji IX heated (x200)

Figure 4. Fuji IX heated (x1000)

Figure 5. Amalgomer CR control (x200)

Figure 6. Amalgomer CR control (x1000)
Figure 7. Amalgomer CR heated (x200)

Figure 10. Fuji IX control intermediate surface (x1500)

Figure 8. Amalgomer CR heated (x1000)

Figure 11. Fuji IX heated top of the intermediate surface (x350)

Figure 9. Fuji IX control intermediate surface (x350)

Figure 12. Fuji IX heated top of the intermediate surface (x1500)
Interface Characteristics

The interface of conventional GICs showed an increase in particle sizes and a decrease in matrix after heat application for both groups. Voids in Fuji IX decreased with heat treatment. The mean particle size of Fuji IX increased from 3-7 μm to 5-10 μm. Texture became denser by heat application (Figs. 9-12).

Amalgomer CR’s original particle size was large and it became larger after heat application. Heated specimens of Amalgomer CR showed a dense structure and there were more particles with larger sizes. The mean particle size increased from 5-10 μm to 30 μm (Figs. 15-18).

Particularly, the top parts, where heat was applied, had a better and more meaningful differentiation. The bottom parts had a less differentiation after the heat treatment (Figs. 11-14 and 17-20).
Woolford\textsuperscript{17} showed an increase in microhardness of GICs with heat. The effect of heat on the setting reaction is likely to make the polyalkenoic acid more active. When the acid contacts the surface of the glass it is able to break down its surface. This will increase the rate at which the ions are leached and released from the glass. A more reactive acid and greater rate of release of ions will lead to a more rapid cement formation by gelation of the insoluble products of the acid and basic glass. The heat would also increase the diffusion rates of the various ions leached from the glass. The total effect of all these accelerated reactions will be to produce a more rapid formation of the calcium polyalkenoate matrix, the components of the first formed matrix\textsuperscript{17}. The application of heat has been shown to affect the setting reaction, at least on the surface of the cement. The top part where heat was applied had a better and more meaningful differentiation; the bottom parts had a less differentiation after the heat treatment in our study too.

In Kleverlaan et al\textsuperscript{18} SEM study, standard or ultrasonic curing samples did not show visual changes in packing of the particles, and temperature was a crucial factor in the setting and reaction time of GICs. According to Algera et al\textsuperscript{20}, beside generation of heat, ultrasound may also contribute to acceleration of the reaction by de-clustering glass particles and enhancing the diffusion of the reaction components. Mechanical properties could be improved as well. The material can be condensed by a reduction of porosity, which is vibrated out of the mix. SEM evaluation did not show de-clustering of the glass particles or a reduction of porosity\textsuperscript{20}.

Gu and Fu\textsuperscript{21} showed that there was an increase in the particle size after heat treatment. This is due to particle agglomeration, coalescence and growth at high temperatures. Voids decreased, particle sizes increased and texture became denser; surface properties of both cements improved with the heat applied in our study too. Particle size distribution influenced the mechanical properties of GICs significantly\textsuperscript{22}.

Yan et al\textsuperscript{23} showed that under wet conditions GICs maintained their original dimensions on heating. Thermal response of GICs when heated is very important clinical implication for the longevity of the restored tooth\textsuperscript{24}. Increasing the powder/liquid ratio can, in principle, improve the surface properties of GICs. Fuji IX is a condensable GIC, but Amalgomer CR is ceramic reinforced GIC, and Fuji IX has higher powder/liquid ratio. The application of heat further increases the evaporation of liquid in GICs and so, due to the heat application, increasing the powder/liquid ratio may cause cracks, for Fuji IX.

**Discussion**


Conclusions

As the heat transfer at study temperatures cannot be conducted all the way through the specimens, major improvements were established in zones that were closer to the heat applied surface. We can conclude that application of heat to improve the surface characteristics of GICs is possible, and heat should be applied on the surface of GICs, particularly within the first 24 hours after setting; it is likely to provide higher abrasion resistance values and less retention zones on the GICs, but further work is necessary to establish the potential effect of heat.

References


Correspondence and request for offprints to:
Berna Kuter
Ege University, School of Dentistry
Department of Pedodontics
Izmir, Turkey
E-mail: kuterberna@yahoo.com
Evaluation of Surface Tensions and Cleansing Ability of Sodium Hypochlorite and Chlorhexidine Solutions at Different Concentrations and Temperatures*

SUMMARY

The purpose of the study was to investigate the surface tensions and cleansing ability of NaOCl and chlorhexidine (CHX) solutions at different concentrations and temperatures. Firstly, the surface tensions of NaOCl (5%, 2.5%) and CHX (2%, 0.2%) solutions were measured at different temperatures (21ºC, 37ºC, 50ºC). Secondly, the canals of 62 single-rooted teeth were instrumented. During preparation, the canals were irrigated with these solutions at different temperatures as mentioned above. The cleansing ability in root canal of the solutions was evaluated by SEM.

The results showed that the difference between means of surface tensions measured at different temperatures and concentrations was statistically significant (p<0.01). Surface tension decreased as heat of the solutions increased. It decreased at low concentration of NaOCl while it increased at low concentration of CHX. In SEM, smear layer on the canal surfaces of teeth treated with solutions was observed. Heat and concentration of solutions influenced the cleansing of canals from superficial debris. The heavy smear layer and more debris was observed at 21ºC with 5% NaOCl while smoother smear layer and less debris was observed at 50ºC with 2% CHX. No solution completely removed debris in apical third, except that 2% CHX at 50ºC.

Keywords: Chlorhexidine; Sodium Hypochlorite; Cleansing Ability; Surface Tension

Introduction

Complete debridement and disinfection of the pulpal space are considered to be essential for predictable long-term success in endodontic treatment. Several irrigating solutions have been used for effective cleansing of root canal during root canal instrumentation because they act as a lubricant, flush debris and bacteria out of the canal, and react with pulp, necrotic tissues and microorganisms and their sub-products.

Sodium hypochlorite (NaOCl) has been used for a long time for this purpose in endodontic treatment. Although it is an effective antimicrobial agent and an excellent organic solvent, it is also known to be irritant to the periapical tissues, mainly at high concentrations. In addition, chlorhexidine gluconate (CHX) has been recommended as a root canal irrigant and many studies have demonstrated its broad-spectrum antimicrobial action, substantivity, and low grade of toxicity. Another advantage of using CHX is that it could be used for patients who are allergic to NaOCl and have teeth with open apices. The major disadvantage of CHX as endodontic irrigant is that it lacks the ability to dissolve necrotic pulp tissue.

Numerous studies have demonstrated that many of the commonly used irrigating solutions are ineffective in completely removing hard and soft tissue debris. The efficiency of an irrigating solution could be related to wettability of the solution, which in turn depends on its...
surface tension. The irrigating solution must be brought into intimate contact with the dentin wall and the debris. Generally, when the surface tension is decreased, the solution can spread more extensively on solid surface. This may be accomplished by the use of heat or the addition of a surfactant\textsuperscript{3,8}.

In some studies, the cleansing effectiveness, bactericidal effect and tissue dissolving effect of NaOCl solutions at various temperatures has been examined. Abou-Rass and Oglesby\textsuperscript{2} have shown that by raising the temperature of the NaOCl solution, its ability to dissolve tissue is potentiated in \textit{in vitro} setting. Cunningham and Balekjian\textsuperscript{10} analyzed the ability of 2 concentrations of NaOCl (2.6\% and 5.2\%) to dissolve collagen at room temperature (21°C) and at body temperature (37°C). The 2.6\% NaOCl at 37°C was seen to be as effective as the 5.2\% concentration, either at 21°C or at 37°C. Berutti and Marini\textsuperscript{7} indicated that NaOCl heated to 50°C has best debridement capability. However, there is no report on the effect of changes in temperature and concentration of both irrigating solutions (NaOCl and CHX) on surface tension.

The purpose of the present study was to investigate changes in surface tensions of NaOCl and CHX at different concentrations and temperatures, and also their cleansing ability in root canals as endodontic irrigant.

**Materials and Methods**

In this study, 5\% and 2.5\% concentrations of NaOCl (Birpa, Ankara, Turkey) and 2\% and 0.2\% concentrations of CHX (Sigma-Aldrich Chemie GmbH, Deisenhofen, Germany) were used at 3 different temperatures, namely 21°C, 37°C, 50°C. The solutions used in the study are shown in table 1.

<table>
<thead>
<tr>
<th>Groups</th>
<th>Solutions</th>
<th>n (teeth)</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>5% NaOCl</td>
<td>5</td>
<td>21 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>37 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>50 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>21 °C</td>
</tr>
<tr>
<td>Group 2</td>
<td>2.5% NaOCl</td>
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<td>37 °C</td>
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<tr>
<td>Group 3</td>
<td>2% CHX</td>
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<td>37 °C</td>
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<tr>
<td></td>
<td></td>
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<td>50 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>21 °C</td>
</tr>
<tr>
<td>Group 4</td>
<td>0.2% CHX</td>
<td>5</td>
<td>37 °C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5</td>
<td>50 °C</td>
</tr>
</tbody>
</table>

**Measuring Surface Tension**

In the first part of the study, the surface tension of each solution was measured at 3 different temperatures by the ring method using the Du Nouy tensiometer (Cambridge Industrial Instruments, London, UK)\textsuperscript{20}. The calibration of the instrument was performed using glycerin. Adequate sample was obtained from each solution and their surface tensions were measured at 21°C, 37°C and 50°C. 8 readings were taken at each temperature and a fresh solution was prepared for each repeated measurement. All measurements of solutions were conducted at room temperature (21°C was considered as room temperature). In order to reach 37°C and 50°C, solutions were heated in a test tube. The temperature of each test solution was adjusted carefully by 1 operator. As a control group, distilled water was used only at room temperature (21°C). After the measurements were done the means were calculated. Statistical analysis of the data was performed using the 2 factors-factorial analysis of variance (ANOVA) and Duncan’s multiple comparison tests.

**Evaluation of Cleansing Ability with SEM**

In the second part of the study, 62 freshly extracted, straight, single-rooted teeth with complete apex formation were selected for the study. Their apical foramen were then sealed with a silicone impression material to prevent irrigation through the apical foramen during root canal preparation. In each tooth, longitudinal grooves, which did not penetrate into the canal, were made on the buccal and lingual surfaces of the roots, to facilitate their fracture. Crowns of all teeth were removed at the cemento-enamel junction. The pulp tissue of teeth was extirpated; teeth which have oval and narrow canals were not used in the study. Then the working length of each root canal was established at 1 mm short of the apical foramen with #15 K-type file (Maillefer/Dentsply, Ballaigues, Switzerland). All canals were instrumented by step-back technique using K-files (Maillefer/Dentsply) to a master apical file size of #45. The middle and coronal thirds were prepared using size 2-4 Gates-Glidden drills (Union Broach, Long Island, NY) with a low-speed handpiece. The teeth were then randomly divided into 4 groups of 15 teeth each for irrigation procedure. As seen in table 1, the solution at each group was prepared at 3 different temperatures (21°C, 37°C, 50°C) and 5 teeth were irrigated at each temperature. Remaining 2 teeth were used as controls and they were irrigated with distilled water at room temperature (21°C).

In all groups, 2ml of experimental solution for each tooth was delivered between each instrument change. Final flush was performed with 5ml of experimental solution and 5ml of distilled water. For each canal, a total of 30ml of irrigant was delivered. A syringe with a 23-gauge needle was used for irrigation and it was placed down the canal until slight resistance was felt. All instrumentation procedures were performed by the
same investigator. After instrumentation, all root canals were dried with paper points. Roots were then fractured longitudinally into halves and stored in neutral-buffered 10% formalin solution until fracture procedures were finished. Then, the root halves were immediately prepared for evaluation under the SEM (JEOL, JSM-5600, Tokyo, Japan). Both fractured halves of each root were mounted on aluminum stubs, vacuum-dried, coated with gold. The superficial debris and smear layer on the canal walls from coronal to apical was evaluated with SEM at 20 kV. Microphotographs of the most representative area of coronal, middle and apical thirds were taken with 1000x magnification.

Results

Surface Tension

Surface tension of distilled water, which was used as control, was measured to be 73 dyne/cm, which is consistent with the literature.17

The results of the statistical analysis of the surface tension measurements are presented in table 2. As it can be seen, means of surface tension values decreased as temperature increased in the each group. The differences between mean values at 3 different temperatures were significant in groups 1, 3 and 4, whereas in group 2, solely the mean value at 21°C was significantly different from those at other temperatures (p<0.01). In addition, the differences between means of surface tension values of different groups measured at the same temperature were significant (p<0.01). At 21°C, the highest mean surface tension value was found in group 1 and the lowest in group 2. The difference in mean values between group 2 and 3 was not significant (p>0.01), whilst the difference between other groups was significant (p<0.01). In solutions heated to 37°C, the highest mean surface tension was observed in group 1 and the lowest in group 3. Mean surface tension values of group 2 and 3 were lower than those of group 1 and 4, with a statistically significant difference (p<0.01). At 50°C, the highest mean value was observed in group 4 and the lowest in group 3; the mean value of group 3 was significantly different than those in the other groups (p<0.01). The mean values of groups 1 and 4 were significantly different than groups 2 and 3 (p<0.01). However, the difference between group 1 and 4 was not significant (p>0.01).

Table 2. The means and standard deviations (SD) of surface tension values (dyne/cm) for each solution at the different temperatures and Duncan’s Test results.

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Group 1 (5% NaOCl) mean ± SD</th>
<th>Group 2 (2.5% NaOCl) mean ± SD</th>
<th>Group 3 (2% CHX) mean ± SD</th>
<th>Group 4 (0.2% CHX) mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 °C</td>
<td>67.13 ± 1.66Aa</td>
<td>50.00 ± 0.70Ca</td>
<td>51.21 ± 0.35Ca</td>
<td>62.69 ± 2.01Ba</td>
</tr>
<tr>
<td>37 °C</td>
<td>55.34 ± 0.63Ab</td>
<td>44.74 ± 0.64Bb</td>
<td>42.83 ± 0.70Bb</td>
<td>52.49 ± 0.96Ab</td>
</tr>
<tr>
<td>50 °C</td>
<td>46.91 ± 1.18Ac</td>
<td>42.85 ± 0.47Bc</td>
<td>35.35 ± 0.75Cc</td>
<td>47.60 ± 0.59Ac</td>
</tr>
</tbody>
</table>

a, b, c: Significant differences between temperatures in the same group (p<0.01). The difference between groups labeled with different superscript letter is statistically significant
A, B, C: Significant differences between groups at the same temperatures (p<0.01). The difference between groups labeled with different letters is statistically significant

Another result was that significant difference was seen between surface tension values at different concentrations of NaOCl and CHX (p<0.01). Surface tension decreased at low concentration of NaOCl solution, while it increased at low concentration of CHX.

SEM Results

Canal surfaces of all specimens were examined from coronal to apical region, and smear layer produced during instrumentation was observed in all specimens. On the canal surfaces of the control specimens, irrigated with distilled water at 21°C, heavy and coarse smear layer and many debris particles were observed (Fig. 1).

Group 1 (5% NaOCl): In specimens irrigated with 5% NaOCl at 21°C, or heated to 37°C, a heavy and coarse smear layer and debris particles were observed at 3 levels (coronal, middle, apical) of the canal (Fig. 2). In
the apical third, these specimens showed more debris than in the coronal and middle thirds. The specimens that had been irrigated with 5% NaOCl heated to 50°C produced a smoother smear layer throughout all canal wall, and fewer debris particles scattered on the smear layer were observed only in the apical third (Fig. 3).

**Group 2 (2.5% NaOCl):** In the specimens treated with 2.5% NaOCl at 21°C cleansing ability of root canal walls seemed similar to the specimens irrigated with 5% NaOCl at 21°C. All canal walls were covered with heavy smear layer and scattered debris particles were present in this layer (Fig. 4). In apical third, debris was more than in the coronal and middle thirds. In specimens irrigated with 2.5% NaOCl at 37°C and 50°C, smear layer became smoother and with less debris as temperature increased. At 37°C and 50°C, debris particles were not observed at coronal and middle thirds, while only a few were observed at the apical third (Fig. 5).

**Group 3 (2% CHX):** In specimens irrigated with 2% CHX at 21°C, 37°C and 50°C, all canal walls were covered with smear layer. The specimens irrigated at 21°C showed a thick smear layer, while canal walls of specimens at 37°C and 50°C were covered with smoother smear layer (Fig. 6). It has been observed that specimens irrigated with 2% CHX at 21°C were present more debris, especially in the apical third, than those at 37°C and 50°C. The specimens at 37°C had better cleansing surfaces without debris at coronal and middle thirds than in the apical third. In these specimens, some partially open dentinal tubule orifices were observed in the coronal third. In the specimens irrigated with 2% CHX at 50°C, clean canal surfaces free of debris were observed at all levels. In these specimens, smear layers at the coronal and middle thirds of canals were partially separated from canal wall and orifices of some dentinal tubules were opened (Fig. 7).
Group 4: In the specimens irrigated with 0.2% CHX at 21°C, 37°C and 50°C canal walls were covered with smear layer. Smear layer had smoother surfaces at 37°C and 50°C than those at 21°C (Fig. 8). The specimens at 21°C and 37°C were observed to have more debris in apical third than in the coronal and middle thirds. In the specimens irrigated with 0.2% CHX at 50°C, clean canal surfaces free of debris were seen at coronal and middle thirds of canal, while small amount of debris was present in apical thirds (Fig. 9).

Discussion

An ideal irrigant must possess some properties such as tissue or debris solvency, low toxicity, low surface tension in order to flow into inaccessible areas, lubrication, sterilization (or at least disinfection), and removal of the smear layer. In endodontic treatment, NaOCl and CHX solutions have been used as root canal irrigants. Cleansing ability, antimicrobial properties, tissue-dissolving ability and biocompatibility of these solutions have been investigated at different concentrations.

In the present study, surface tensions of NaOCl and CHX solutions at different concentrations and temperatures have been evaluated and their cleansing ability in root canals as endodontic irrigant investigated.

In this study, surface tension values of both solutions varied with concentrations and temperatures. When 2 different concentrations of NaOCl solution have been
compared, it was observed that 2.5% NaOCl had lower surface tension than 5% NaOCl. Abou-Rass and Patoni\textsuperscript{3} and Taşman et al\textsuperscript{20} investigated the surface tension values of some solutions and reported that NaOCl had lower surface tension at lower concentrations. Our findings are congruent with theirs. In addition, changes in the temperature of solutions influenced surface tension, with lower surface tension values as temperature increased, which is related to the physicochemical structure of the solutions\textsuperscript{6}. When the solution with low surface tension is in contact with a solid surface, it spreads to a larger area and increasing wettability influences cleansing ability favorably\textsuperscript{3,8}.

Surface tension of CHX was lower than NaOCl and this result is similar to those of Giardino et al\textsuperscript{12} and Poorni et al\textsuperscript{19}. In the investigation of CHX solution at both concentrations, surface tension was found to be lower at 2% concentration compared to 0.2% concentration at 3 different temperatures. CHX itself is a cationic active agent that reduces the surface tension of the solution to which it is added. Therefore, surface tension is lower at higher concentrations of CHX solution. As seen in NaOCl solutions, surface tension values of CHX solution decreased as temperature increased, with a significant difference (p<0.01).

Cleaning is one of the main objectives of root canal preparation. The persistence of residual pulp tissue, infected dentine or bacteria in the canal system may be responsible for treatment failure. The use of irrigating solutions facilitates debridement of the root canal space and is important for the success of root canal treatment\textsuperscript{5,10,18,22}. NaOCl is considered to be most suitable endodontic irrigant thanks to its bactericidal and lubricant properties and being a solvent of organic substances\textsuperscript{7}. CHX has been used as endodontic irrigant. The specimens treated with 2% CHX presented thinner smear layer covered surfaces than NaOCl. Ferraz et al\textsuperscript{11} investigated the cleansing ability of 5.25% NaOCl, 2% CHX and CHX gel as an endodontic irrigant. The specimens treated with 2% CHX presented thinner smear layer covered surfaces than NaOCl. Abbott et al\textsuperscript{1} evaluated the cleaning capacity of Savlon (0.03% CHX + 0.3% cetrimide) and reported the removal of residue from root-canal walls. However, Cheung and Stock\textsuperscript{2} did not find a significant difference between the cleaning capacity of 1% NaOCl and Hibiscrub (0.5% CHX). Yamashita et al\textsuperscript{22} reported that cleansing ability of 2.5% NaOCl was better than that of 2% CHX; yet, cleaning with CHX was similar to that with NaOCl at cervical third.

Debris of the apical third cannot be totally cleaned with all solutions, except with 2% CHX solution heated to 50°C. This is in agreement with current literature\textsuperscript{1,3}. The decreasing diameter of the root canal and the consequent decrease in the flow of the irrigant probably explain this difficulty\textsuperscript{22}. Especially in narrow canals, concomitant use of solutions with low surface tension at canal preparations may be more beneficial for apical cleaning.

In conclusion, surface tensions of NaOCl and CHX solutions varied with both temperature and concentration. As temperature of solutions increased, surface tension decreased; however, the effect of concentration on surface tension was different for both solutions. Surface tension
decreased at low concentration of NaOCl solution, while it increased at low concentration of CHX. It has been observed that the solutions cannot remove smear layer from root canal walls. At high temperature, the solutions left a smear layer with smoother surfaces and cleaner canal walls, free of debris, than those at room temperature. Surface tension of 5% NaOCl was higher than that of 2.5% solution, but it is not superior to 2.5% solution in terms of cleansing ability; lower concentrations may be recommended in view of the toxic nature of the material. Concerning CHX solutions, 2% concentration had lower surface tension and better cleansing performance than 0.2% solution. It is our suggestion that if CHX solution is preferred as a root canal irrigant, 2% concentration should be employed due to its cleansing performance. However, further investigations are needed on the subject.

References


Correspondence and request for offprints to:
Assoc. Prof. Semra Sevimay
Ankara Üniversitesi
Diş Hekimliği Fakültesi
Endodonji ABD
Besevler, 06500
Ankara, Turkey
E-mail: ssevimay@dentistry.ankara.edu.tr
Dental Management of 2 Different Tooth Wear Cases

SUMMARY

Tooth wear is considered to be pathologic when the loss of tooth surface is excessive to the extent that it affects the appearance or function of the dentition or causes discomfort. Tooth wear has been subdivided into 3 categories: attrition, abrasion and erosion, usually based on etiologic factors and clinical manifestations. In this article, 2 patients (30 and 56 year old men), who complained about aesthetics and sensitivity related to tooth surface loss and were treated with metal-ceramic crowns, are reported.

Keywords: Erosion; Attrition; Abrasion; Tooth Wear; Occlusion.

Introduction

Tooth surface loss (TSL) or tooth wear is usually found in every dentition and may have physiologic and pathologic causes. The wear of teeth is irreversible and cumulative with age. Tooth wear is considered excessive or pathologic when compared with the amount of wear typical for the patient’s age and when an intervention is necessary for cosmetic or functional purposes.

TSL can arise as a result of attrition, abrasion and erosion, based on etiologic factors and clinical appearances. Attrition is a gradual loss of the dental hard tissues as a result of functional or parafunctional activity of the teeth; abrasion is a pathologic tooth wear caused by the frictional action of a foreign body on the teeth, such as that caused by tooth brushing; erosion is the loss of hard tooth substance due to a chemical process not involving bacteria. In many cases a combination of etiologic factors complicates the diagnosis and modifies the clinical appearance or pattern of tooth wear.

The rate of wear may be greater by the factors such as: age, gender, occlusal condition, parafunction, gastrointestinal disturbances, excessive intake of acidic fruits or beverages with a low pH, environmental and salivary factors, and congenital anomalies such as amelogenesis imperfecta and dentinogenesis imperfecta.

Although a classical clinical appearance has been described for attrition, abrasion and erosion, it is unlikely that the appearances described are a result of a single factor. Certain clinical features can indicate a dominant etiologic factor.

Attrition produces wear facets on the occluding surfaces of teeth, including the incisal edges. This commonly begins soon after eruption or may start later in life. Eventually the cusps become flattened, the incisal edges are shortened, and dentin is exposed. Following dentine exposure, the clinical appearance is determined by the relative contributions of the etiological factors. If the TSL is primarily attritional, then the dentine will wear at the same rate as the surrounding enamel. In this situation the shape of the facet will be determined by the movement of the opposing tooth.

Abrasion has been assumed to be associated with over-zealous tooth-brushing, especially along the cervical margins of the canines and premolars. Cervical lesions caused by an abrasive force tend to be angular and V-shaped.

Erosions typically present as bilateral concave defects without the chalkiness or roughness normally associated with bacterial acid decalcification. In its early stages, erosion affects enamel, resulting in a shallow, smooth, glazed surface that usually lacks developmental ridges and stain lines.

TSL may cause an increase in tooth translucency both interproximally and at the incisal edges. Continued TSL may produce fractures of the enamel and shortening of the teeth. The loss of enamel may also increase the

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visibility of the underlying dentine, producing a more yellow tooth colour.

As the person becomes older and the wear continues, there is gradual reduction in cusp height and consequent flattening of the occlusal inclined planes. This gradual loss of enamel and dentin does not usually result in tooth sensitivity because of secondary dentin formation. In severe cases the length of the crowns is markedly shortened which may lead to a reduction in the vertical dimension of occlusion (VDO). Owning to compensatory eruption of teeth, the extent of occlusal surface loss is not always reflected by a similar decrease in the VDO or increase in inter-occlusal distance. Inter-occlusal distance may be measured by the distance between 2 points; one marked on the patient's nose and another on the chin. It is made in centric occlusion to find the VDO and in centric relation; the mandible in rest position to find the vertical dimension of rest (VDR). For the patient with a loss of VDO, an occlusal splint and/or prosthodontic rehabilitation is necessary to prevent the posterior teeth interferences in lateral and protrusive movements; reduces eccentric loading on the temporomandibular joint (TMJ).

This clinical report describes the treatment plan of 2 patients (30 and 56 year old men) who complained about aesthetic and sensitivity because of erosion and abrasion related TSL.

**Case Reports**

2 patients (30 and 56 year old men) were referred to the Prosthetic Dentistry Department of Marmara University Faculty of Dentistry for the treatment of severe tooth wear.

**Case 1**

A 30-year-old man was referred for treatment of poor aesthetics and considerable sensitivity of his teeth. Intraoral examination revealed metal-ceramic crowns at the maxillary anterior region (Fig. 1) and eroded occlusal tooth surfaces of the cusp tips of the maxillary posterior teeth (Fig. 2). There were no eroded areas at the mandibular teeth. These lesions are thought to be the result of the tongue directing gastric contents forward during voluntary and prepared vomiting with the lateral spread of the tongue protecting the lower teeth. He was vomiting consciously in order to lose weight. It was examined that there was no decrease in the VDO, because the anterior metal-ceramic restorations were not affected by the acid exposure during vomiting.

For the treatment of the patient, it was decided to restore all of the maxillary teeth with metal-ceramic fixed dentures in the same VDO. To obtain the same VDO, wax bite records were taken from the side of prepared teeth when the other side were not prepared. All maxillary teeth were prepared in chamfer type margin and impression was taken by using silicone material (Speedex; Coltène/Whaldent Inc, Cuyahoga Falls, Ohio). The casts were formed and mounted in a semi-adjustable articulator (Artex; Girrbach Dental GmbH, Pforzheim, Germany) with the dies of prepared maxillary teeth trimmed. All teeth were restored with metal-ceramic crowns (VMK-95 Metall Keramik; Vita Zahnfabrik, Bad Säckingen, Germany - Fig. 3) that also provided canine protected occlusion and were luted with glass ionomer cement (Ketac Cem μ; 3M Company, Seefeld, Germany). At the sixth month recall the patient own appreciation of the prosthetic therapy was high.
Case 2

A 56-year-old man complained about the poor appearance of his teeth which had worn away. Intraoral examination of this patient revealed severe TSL on the occlusal and incisal surfaces of maxillary and mandibular teeth due to aging (Figs. 4 and 5).

The patient’s dental treatment was extensive and required interdisciplinary care. The VDO and VDR of the patient were measured and the difference between 2 measurements were 4 mm. Diagnostic casts were made and mounted in centric relation by the records of facebow (Artex Rotofix-Facebow; Girrbach Dental GmbH, Pforzheim, Germany) in a semi-adjustable articulator. To increase the VDO, an occlusal splint for maxillary arch was made using auto-polymerizing acrylic resin (Fortex; International Dental Surgical and Industrial Polymer Suppliers, Durham, England). The splint was made 4 mm thick to increase VDO as VDR with canine protected occlusion (Fig. 6). The patient was instructed to wear the splint except when eating. The vertical dimension of the splint was reduced once a week for a 3-week period. After this period of time, when the patient reported no discomfort, the prosthodontic treatment was started. The splint was separated at the midline and was used in the reduction of right maxillary and mandibular teeth for fixed crowns (Fig. 7). By referencing the left part of the splint, provisional acrylic resin (Dentalon plus; Heraeus Kulzer GmbH & Co. KG, Hanau, Germany) crowns were prepared for the right maxillary and mandibular prepared teeth. By referencing of the provisional crowns on the right side, the tooth reduction and provisional crowns were prepared for the maxillary and mandibular left quadrants. All of the provisional crowns were luted with eugenol-free zinc oxide cement (Prevision Cem; Heraeus Kulzer GmbH & Co. KG, Hanau, Germany). The patient was instructed to wear the provisional crowns for a period of 2 weeks, to determine whether any functional problems existed.
All maxillary and mandibular teeth were prepared in shoulder type margin and impressions were taken by using silicone material (Speedex; Coltène/Whaledent Inc, Cuyahoga Falls, Ohio). The casts were formed and mounted in a semi-adjustable articulator with the dies of prepared teeth trimmed. The casts were mounted in the articulator by the reference of wax bite records which were taken when the one side provisional crowns in situ, so that the other side of wax record was obtained. By this method, the VDO with provisional crowns was copied to provide the same VDO for definitive restorations. All teeth were restored with metal-ceramic crowns (VMK-95 Metall Keramik; Vita Zahnfabrik, Bad Säckingen, Germany) that provided canine protected occlusion (Fig. 8). All of the metal-ceramic crowns were luted with glass ionomer cement (Ketac Cem μ; 3M Company, Seefeld, Germany). At first year recall, the patient reported no problem.

Discussion

The reconstruction of a severely worn dentition is a very complex and difficult problem, representing a real challenge to the dentist\(^2\). This manuscript represents 2 case reports which have different clinical appearance of TSL and their prosthodontic rehabilitations. Case 1 differentiates from the second one according to their aetiology. In Case 1, severe erosion lesions were seen because of patients’ vomiting. However, in Case 2, attrition was seen due to the old age of the patient.

A careful clinical examination and a thorough case history (dental, medical, diet and eating habits, occupation, bruxism, or any other oral habits) are important for diagnosis and treatment planning\(^1\). When teeth become worn, a serious problem is created; especially if there is no vertical space for restorations and the patient has reduced facial height, an alteration in the VDO is necessary\(^2\). In Case 2, an increase in VDO was needed. However, in Case 1, there was no decrease in the VDO because the anterior metal-ceramic restorations prevented tooth wear and erosion of anterior teeth by acid exposure during vomiting. Sato\(^2\) has applied a maxillary occlusal splint to increase VDO to a patient that had tooth wear. The patient was instructed to use the splint for 4 months. Also, in the same case, provisional crowns have been used for 6 months\(^2\). In Case 2, the patient was instructed to use the splint for a month and the provisional crowns for 2 weeks. Although the periods of the patient’s occlusal splint and provisional crowns usage were shorter than in the Sato’s case\(^2\), the patient reported no problem.

In these case reports, a satisfactory clinical result was obtained by constructing the correct VDO, with an improvement in aesthetics and function.

References


Correspondence and request for offprints to:
Rifat Gozneli
Marmara Üniversitesi, Dişhekimliği Fak.
Güzelbahçe, Büyük Çiftlik Sokak
No: 6, 34365, Nişantaşı
İstanbul, Turkey
E-mail: rgozneli@superonline.com
Lamotrigine-Induced Steven-Johnson Syndrome: A Case Report

SUMMARY

Steven-Johnson syndrome (SJS) or erythema multiforme major is recognized as a severe form of erythema multiforme that predominantly involves the mucous membranes. Drugs are clearly the main causative factor and only few cases appear to be linked to infections or other factors. Prodromal systemic illness such as fever, cough, weakness, malaise, sore throat, arthralgia, myalgias and diarrhea usually precedes the appearance of bullae and erosion on the mucosal membranes.

SJS can be a mild-to-life-threatening process after exposure to many antiepileptic drugs. The increased use of antiepileptic drugs for treatment of bipolar disorder and neurologic disorders has extended the risk of exfoliative disorder to this population of patients, and these patients and their health care providers may not be familiar with the risks involved with these drugs. Lamotrigine (LTG) is a novel antiepileptic drug effective in partial and generalized seizures. Recently, this drug has started being used for mood stabilization in psychiatric patients. This report presents the diagnosis and management of Lamotrigine-induced severe oral lesions of a 76-years-old woman with bipolar disorder.

Keywords: Lamotrigine; Steven-Johnson Syndrome; Oral Lesions

Introduction

Steven-Johnson syndrome (SJS) or erythema multiforme major is recognized as a severe form of erythema multiforme that predominantly involves the mucous membranes. Drugs are clearly the main causative factor and only few cases appear to be linked to infections or other factors. Prodromal systemic illness such as fever, cough, weakness, malaise, sore throat, arthralgia, myalgia and diarrhea usually precedes the appearance of bullae and erosions on the mucous membranes.

The oral mucosa is invariably involved, with extensive formation of the bullae, followed by extremely painful erosions covered by greyish-white or hemorrhagic pseudo-membranes. The lips usually show characteristic bloody crusting. Erosions may extend to pharynx, larynx, oesophagus and respiratory system. The ocular lesions consist of conjunctivitis, but corneal ulceration, anterior uveitis or panophthalmitis are not rare and sometimes may lead to symblepharon, corneal opacity or even blindness. The genital lesions consist of balanitis or vulvovaginitis. The skin lesions are variable in extent. They may be the typical macula-papular eruption of erythema multiforme, but more commonly are bullous or ulcerative.

Lamotrigine (LTG) is a new antiepileptic drug, effective in partial and generalized tonic-clonic seizures. In 2003, the Food and Drug Administration (FDA) approved LTG for the maintenance treatment of bipolar I disorder to delay the time to occurrence of mood episodes such as depression, mania, hypomania and mixed episodes, in adult patients treated for acute mood episodes with standard therapy. Side effects are mostly related to the central nervous system and include headache, nausea, vomiting, dizziness, diplopia and ataxia. Cutaneous side effects are seen in 3% to 10% of patients. These
are mostly maculopapular eruptions beginning within 2 weeks of the therapy. In some patients, rash subsequently disappears, despite the continuation of therapy. However, in some patients, these side effects may be very severe, requiring drug discontinuation, or may even end up with the death of the patient.6

We describe a case of 76-years-old woman with bipolar disorder treated with LTG, after poor responses to other drug regimens. Painful, erythematous, erosive, lesions on buccal and labial mucosa and erosive, bloody crusts on lips and nose had developed, after she had started treatment with LTG. The diagnosis and management of SJS with LTG-induced severe oral adverse reactions were presented.

Case Report

A 76-years-old woman applied to Istanbul University, Faculty of Dentistry, Department of Oral Medicine and Surgery with the complaint of severe oral mucosal reactions. The medical history revealed that she was under regular review in psychiatric clinic for 7 years and treated with Lithium carbonate (Lithuril 300 mg), Ketapin (Seroquel), Propranolol HCl (Dideral) for 4 years. Because of the poor control of symptoms, Lamotrigine chewing tablets (Lamictal Chewable Dispersible Tablets) was added to the treatment with the dose of 25mg/day. 4 days after the treatment onset, an angioedema developed around the mouth and eyes and after one dose of systemic corticosteroid therapy (40 mg prednisolon IM), complaints regressed. But on the following day, extremely painful erosions covered by greyish-white and hemorrhagic pseudo-membranes on oral mucosa and erosive, bloody crusts on lips and nose were developed. She immediately discontinued the LTG therapy and came to our clinic.

On physical examination, she had a temperature of 39.5°C and a general body weakness. There were no skin eruptions throughout the body except nose, oral and perioral area. Extraoral examination revealed perioral oedema, erythematous, erosive, painful, bloody crusts on the lips and erosive lesions on the nose (Figs. 1 and 2). Intraoral examination revealed bullae, extremely painful erosions covered by greyish-white and hemorrhagic pseudo-membranes, both on buccal and labial oral mucosa. Opening of the mouth was limited and it was very difficult to examine the oral cavity; anyway, a punch biopsy from the labial mucosa of the lower lip was hardly performed under local anaesthesia (Fig. 3).

After the first examinations in our clinic, the patient was referred to dermatology department for consultation. Laboratory examinations, including complete blood count, liver and kidney functional tests, electrolytes, erythrocyte sedimentation rate, urine analysis and chest radiograph were all in normal limits. Urine, throat cultures and indirect immunofluorescence blood analysis were negative. The histopathological examination confirmed the SJS.

After the diagnosis of LTG-induced SJS was established, the patient was hospitalized in dermatology clinic and oral prednisolone 60 mg per day and intravenous fluids were given initially. Topical steroid gel (Triamcinolone asetonate) and viscous lidocaine were applied to patients lips and oral mucosa. On the fourth day of hospitalization prednisolone was started to decrease gradually and a mouthwash consisting of diphenhydramine, viscous lidocaine and sodium bicarbonate was prescribed. The immediate withdrawal of LTG and treatment with steroids was followed of a slowly favourable course with disappearance of symptoms 8 days later (Figs 4 and 5). On the hospital day 10, the patient improved substantially and after psychiatric consultation, the patient was discharged home.
Discussion

SJS is severe, life-threatening reaction that has been associated with more than 100 different medications. These reactions are characterized by erythema and tenderness of skin and mucosa, fever, skin blistering or crusting, ulceration of the mucous membranes and subepidermal separation.

LTG, a phenyltriazine, is extensively metabolized, predominantly by N-glucuronidation, whereas only minor fractions undergo N-oxidation and N-methylation. It has a wide range of efficacy for partial and generalized seizures and is effective as carbamazepine and phenytoin when used as monotherapy in newly diagnosed epilepsy. LTG is being investigated for variety of additional indications, such as bipolar disorders, cocaine abuse, trigeminal neuralgia and postoperative analgesia.

Most of adverse drug reactions attributed to LTG therapy are related to the central nervous system and include headache, nausea, vomiting, diplopia and ataxia. The prescribing information for LTG reports a 1% risk of SJS in paediatric population and 3% in adults. Subsequent to its FDA-approved indication for the treatment of bipolar I disorder, LTG has gained popularity among patients with bipolar and other mood disorders. In clinical trials of LTG effectiveness in the treatment of bipolar and other mood disorders, 0.08% of adults who received LTG as monotherapy developed rash. The rate was 0.13% in patients receiving the drug as adjunctive therapy. The risk of rash increased when valproic acid was co-administered, exceeding the recommended initial dose and the rate of dose adjustments.

In the series of 57 cases with LTG-induced severe cutaneous adverse reactions (SJS or Toxic Epidermal Necrolysis), Schlienger et al. found a significant difference in the age distribution. Patient with SJS were significantly younger and the percentage of patients who were <18 year of age was significantly higher in the SJS group. Our patient was 76 years old and, regarding age, our finding does not correspond with the published data.

The typical interval from beginning of a drug therapy to the onset of reaction in patients with SJS is usually 1-3 weeks. In 2 SJS cases from World Health Organization records, the onset was relatively short (2 and 4 days). In our patient, adverse reaction firstly developed as perioral oedema, but after 1 dose of systemic corticosteroid injection, the symptoms regressed partially; however, severe reactions developed on the fifth day of the LTG treatment. No skin reaction developed on the body in our patient in contrast with other reported cases in the literature; therefore we conclude that application of one dose systemic corticosteroid, after the occurrence of perioral oedema, prevented more severe reactions.

Certain precautions can help to prevent serious rash associated with LTG. Among the most important...
preventive measures are appropriate dosage and its adjustment. In adults, the recommended initial dose of LTG alone is peroral 25 mg daily for the first 2 weeks, 50 mg daily during 3 and 4 weeks and then weekly increases of 50-100 mg per day as clinically indicated. Despite the prescription of recommended initial dose of LTG, severe oral adverse reactions developed in our patient.

In conclusion, severe adverse reactions following LTG treatment can occur even when a low starting dose was given. Therefore, patients who begin the LTG treatment should be observed for the development of both skin and mucosal reactions and if indicated the agent should be withdrawn or replaced, depending on the necessity of the therapy. Serious drug-induced eruptions associated with LTG are rare and although SJS is a potentially life-threatening syndrome, clinicians must weigh the risk benefit of this medication with more common risks associated with untreated bipolar depression. The role of dentists in the diagnosis of the SJS is very important. SJS should be considered in patients having suspicious drug history with intraoral erosions and ulcerations, and also biopsy must be performed for final diagnosis.

References


Correspondence and request for offprints to:
Dr. Meltem Koray
Istanbul Universitesi, Diş Hekimliği Fakültesi
Ağzı, Çene Hastalıkları ve Cerrahi Anabilim Dalı 6. Kat
Fatih, İstanbul
E-mail: mkoray@istanbul.edu.tr
Introduction

Salivary glands are divided into major and minor salivary glands. The rate of secretion of individual glands ranges from barely perceptible during sleep to as high as 4 ml/min on maximal stimulation. It has been reported that of total salivary secretion (1.5 l/day), approximately 75% is secreted by the submandibular glands, 20% by the parotid glands and the rest by sublingual and other salivary glands1. Furthermore, salivary secretions from individual types of glands differ. The parotid gland secretes protein rich saliva with enzymes like amylase, while the submandibular gland secretes mucin rich saliva, which is useful in lubricating the bolus of food before ingestion2.

Sialolithiasis is a condition characterized by the obstruction of a salivary gland or its excretory duct due to calcareous concretions. It is a common disease of the major salivary glands. It mainly affects the submandibular gland (80-90%) and to a lesser degree the parotid gland (5-20%). The sublingual and the minor salivary glands are rarely affected. It may occur at all ages but there is a peak incidence during the 4th, 5th and 6th decades3.

The classic treatment of sialolithiasis includes antibiotics and inflammatory agents, hoping for a spontaneous stone expression through the papilla. In cases of anterior located submandibular stones, a sialodochoplasty is the treatment of choice, whereas submandibular gland removal is indicated if the sialoliths are not accessible intraorally. In cases of posterior located or intraglandular parotid stones, a conservative approach is usually adopted, probably because parotidectomy for infectious conditions is associated with a high incidence of facial nerve complications4. External lithotripsy, initially described by Iro et al5, is becoming popular and success rates up to 75% for the parotid and up to 40% for submandibular gland are reported6. Sialoendoscopy is also a relatively recent technique for the removal of salivary stones. Other techniques for salivary stones fragmentatin using electrohydraulic and pneumatic devices have been described, but their use is not recommended due to injuries of the canal wall that have been reported7,8.

It has been found on autopsy that 1% of the population has sialolithiasis9. However, bilateral sialolithiasis is an extremely uncommon condition. In Tholen’s series of 97 cases of sialolithiasis, only 1 was bilateral10, whereas in Levy’s series, only 4 patients among 180 had bilateral sialolithiasis11. As far as the
submandibular gland is concerned, Mela et al\textsuperscript{12} found only 3 cases of bilateral submandibular sialolithiasis among 245 patients. Lustmann et al\textsuperscript{13} reported an incidence of 1\% of bilateral submandibular sialolithiasis in autopsy materials. We present 2 rare cases of bilateral submandibular sialolithiasis with concurrent sialadenitis.

**Report of 2 Cases**

**Case 1**

A 40-year-old male came to our department complaining of a history of recurrent swelling in the submandibular region on both sides. Past medical history revealed psoriasis, whereas family history was unremarkable. Review of systems revealed no pathologic findings and vital signs were within normal limits.

On physical examination, a mild swelling of the submandibular regions was discernible, which felt firm and revealed no tenderness on palpation. The overlying skin was freely mobile and no signs of cellulitis were present. On bimanual palpation calculi were palpable in both submandibular ducts.

The mandibular occlusal radiograph and panoramic radiograph showed calcifications within the left submandibular gland and radiopacities in both submandibular ducts. A CT scan was ordered to better delineate the size and extent of calcifications (Fig. 1).

A diagnosis of bilateral submandibular gland sialolithiasis with obstructive sialadenitis was made. The patient was placed on IV clarithromycin and was scheduled for left submandibular gland excision and right transoral stone removal with concurrent sialodochoplasty. The operation was carried out under general anaesthesia \textit{via} nasotracheal intubation. On the right side, a longitudinal incision was made over the calculus, exposing it. The calculus was removed and a sialodochoplasty was performed (Fig. 2). The incision on the left side was made over a natural skin crease below the lower border of the mandible (Fig. 3). The submandibular gland was dissected out without complications. Healing occurred uneventfully.

**Case 2**

A 44-year-old female was referred for evaluation and treatment of submandibular swelling. The patient complained of submandibular swelling accompanied by severe pain below the right side of her jaw at mealtime. Her medical history revealed a 16-year history of Systemic Lupus Erythematosus (SLE) and mild to moderate hypertension, which was effectively controlled by medication. Review of systems was remarkable for mild hypertension. Laboratory exams revealed elevation of WBC count (15.2x10\(^9\)/L) and positive ANA, antiSSA, antiSm and antiRNP antibodies due to her systemic disease.
On physical examination the right submandibular area was markedly oedematous, firm and tender. A calculus was palpable intraorally along the course of the right submandibular duct. The left submandibular gland and duct revealed no pathologic findings on palpation. Imaging consisting of panoramic radiograph and CT scan revealed bilateral submandibular sialolithiasis (Fig. 4).

Our patient had no symptoms in the left submandibular region. We informed her, however, that if the sialolith remained in place it would probably cause the same symptoms of obstructive sialadenitis that she had experienced on her right submandibular gland, and that another operation would be indicated to remove the gland. For all the reasons mentioned above, the patient agreed to have both the submandibular glands removed simultaneously. In view of the inaccessibility of the stones to simple intraoral surgery, bilateral submandibular gland removal was undertaken via nasotracheal intubation (Fig. 5).

The specimens were sent for histopathologic evaluation. The affected lobules of the right submandibular gland showed intralobular fibrosis and a considerable amount of chronic inflammatory cells infiltration. These findings confirmed the diagnosis of chronic sialadenitis. Microscopic examination of the left submandibular gland revealed mild inflammatory changes centred around small and large ducts.

The patient recovered uneventfully and 12 months later she was free of further symptoms. Despite the fact that both her submandibular glands were removed, she did not complained of decreased salivary flow or of any difficulties in chewing, speaking or swallowing.

**Discussion**

Sialolithiasis is the most common disease of the salivary glands in the middle-aged patients. It occurs mainly in the submandibular gland (80-90%) and to a lesser degree in the parotid gland (5-20%)\(^3\). Calculi formation is more common in submandibular gland because of its longer duct, its slower rate of saliva flow, its viscous secretions of high alkalinity and its high calcium content of saliva\(^4\).

The nucleus of the salivary stones is inorganic and is mainly composed of calcium carbonate. Around this nucleus, organic and inorganic substances accumulate in a laminated concentric fashion\(^5\). Submandibular stones are thought to form around a nidus of mucous, whereas parotid stones are usually formed around a nidus of inflammatory cells or around a foreign body\(^6\). It is thought that stagnation of calcium rich saliva, combined with unclear metabolic events, contribute to calculi formation\(^7\). Risak\(^8\) was the first to support that bacteria of the oral flora are associated with stone formation and Teymoortash et al\(^9\) identified oral bacteria (especially streptococcus species) in sialoliths. They state that these bacteria play a potential role in the etiopathogenesis of sialolithiasis.

Sialolithiasis occurs in the right and left submandibular gland with the same frequency, but simultaneous sialolithiasis in more than 1 gland is a rarity. That is because sialolithiasis is probably caused by local factors and not by systemic disorders. Past medical history and laboratory exams of both our patients revealed no evidence of hypercalcaemia or hyperparathyroidism or any other metabolic or hormonal disturbance. In fact, in reviewing the literature, gout is the only systemic disease
that is known to cause sialolithiasis. In this case the salivary stones are radiolucent because they are mainly composed by uric acid\textsuperscript{2}. Disturbances in the viscous secretions of the salivary glands occur in patients with cystic fibrosis, although it is not known if these patients have an increased prevalence of sialolithiasis\textsuperscript{15}. The coexistence of sialolithiasis and nephrolithiasis has also been mentioned by some authors\textsuperscript{14,19}, but we found no correlation between sialolithiasis and autoimmune diseases, such as psoriasis and lupus in the literature.

Conventional radiographs, such as panoramic radiograph and mandibular occlusal radiograph, reveal submandibular sialolithiasis in 80-94.7\% of cases\textsuperscript{16}. Ultrasound is helpful especially in parotid sialolithiasis since it detects 90\% of stones greater than 2 mm. High resolution CT scan has proven superior to conventional radiographs and ultrasound in detecting sialolithiasis, because its sensitivity makes it possible to detect recently calcified calculi which cannot be detected through conventional radiography\textsuperscript{20,21}. This is the reason why it is advisable to request it always before surgical intervention.

The most common symptom of sialolithiasis is swelling followed by pain, which usually correlates with meals. The increased salivary secretion in the obstructed gland leads to an elevated intraglandular pressure, which causes pain to the patient\textsuperscript{13}. Since obstruction is rarely complete, the gland swelling will subside to some degree, but in chronic gland obstruction, some swelling and induration may persist even after stone removal due to inflammation and fibrosis of the gland.

Bilateral submandibular sialadenitis may be due to obstructing calculi, low grade bacterial infection or a lympho-epithelial disease such as Sjögren syndrome\textsuperscript{22}. If complete obstruction has occurred, local cellulitis may be present. The superficial layer of deep cervical fascia, which envelops the gland, limits the spread of infection. However, prolonged swelling and inflammation process can weaken the fascia and allow the infection to spread into the submandibular space\textsuperscript{23,24}. The progression of infection from both glands caused by bilateral submandibular sialolithiasis, coupled with oedema of the floor of the mouth, can form a picture that is consistent with Ludwig’s angina and carries the same morbidity\textsuperscript{25,26}.

The treatment of choice of the submandibular gland sialolithiasis is the removal of the obstructing stone by an intraoral approach. Stones in the anterior or middle third of the submandibular duct can be removed with an intraoral approach\textsuperscript{27}. Sialendoscopy may be curative if the stone is located more distally in the duct\textsuperscript{28}. While the mainstay of treatment of sialolithiasis is surgery, some authors implement a trial of conservative therapy, consisting of gland massage, adequate hydration and anti-staphylococcus antibiotics, especially when the stones are inaccessible to intraoral approach\textsuperscript{18,29,30}. They state that the conservative approach is preferred to the extraoral gland removal because of the high risk of damage to nerves, such as the lingual, hypoglossal and facial nerve, during the operation and because of the visible scar that is left. On the other hand, one should keep in mind the complications that can result from recurrent sialadenitis. If an acute sialadenitis occurs, there is a danger of abscess formation, which can result in sinus and scar formation far more unsightly than the surgical scar. Furthermore, longstanding recurrent sialadenitis leads to formation of fibrous adhesions and distortion of normal anatomy\textsuperscript{31}. Removal of the gland, if it is eventually needed, is far more complicated and carries a greater risk of causing damage to the regional nerves. Furthermore, Preuss et al\textsuperscript{32} have recently analyzed 258 unselected submandibular excisions and they found a low rate of transient palsies of the mandibular branch of the facial nerve (9\%) and lingual nerve (2\%). To date, it is not known that routine facial nerve stimulation devices could further reduce the risk of transient nerve palsy.

As we mentioned before, new endoscopic techniques allow the conservative removal of salivary stones in a considerable number of cases. However, it remains unclear whether the incidence of complications is lower in comparison with conventional surgical excision of the gland. Analysis of complications of interventional sialoendoscopy in a large series of patients revealed no major complications, but the long-term success rate of this procedure is still unknown\textsuperscript{33}, although in the case of parotid sialolithiasis, endoscopy has proven to be superior to other techniques\textsuperscript{34}. Recently, shock wave lithotripsy was introduced for the treatment of sialolithiasis. Shock waves crush the calculus \textit{in situ} and the fragments are rinsed through the duct by salivary flow. The results show that 40-50\% of patients are rendered stone free\textsuperscript{35}, although the overall success rate in patients with parotid gland calculi was far better than in patients with submandibular sialolithiasis\textsuperscript{36}. Furthermore, lithotripsy is performed with special and expensive equipment, which is not available in our hospital and this is the reason why we did not consider treating our patients with this technique. If these new procedures prove to be safe in long-term studies, they certainly promise a successful conservative treatment option for a large number of patients with submandibular sialolithiasis.

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Correspondence and request for offprints to:
Lazaridou Maria
Neohoriot 16, Neapoli
56727 Thessaloniki
Greece
e-mail: lazaridoudm@yahoo.gr
SUMMARY

Cysts of the temporomandibular joints (TMJ) are rare. A patient with chief complaints of pain and swelling in the left preauricular region was examined. Clinical examination and magnetic resonans imaging (MRI) findings showed 2 cystic lesions around left TMJ. The differential diagnosis and management of the cysts are discussed.

Keywords: Ganglion Cyst; Temporomandibular Joint

Introduction

Ganglion and synovial cysts of the temporomandibular joints are very rare. These 2 types of lesions are usually referred synonymously as differential diagnosis usually lacks. They mostly occur on the wrist, ankle, foot and the knee. Due to their anatomic locations, temporomandibular joint cysts are usually evaluated as parotid masses. Though the etiology is unknown, some of the cases had a history of trauma and it may be implicated in their origin. Ganglion cysts seem to arise from myxoid degeneration of the joint capsule and are departed from the joint cavity. The filling is a gelatinous material lined with fibrous connective tissue without synovial cells. Synovial cysts are herniations of the synovium into the surrounding tissues. They are lined by the synovial originated cuboidal or flattened cells unlike ganglion cysts. Although both types of cysts may occur following a trauma, only synovial type of cysts may form after a primary inflammatory process.

A Case Report

Clinical Examination

A 48-years-old woman was referred by a physiotherapist to the Istanbul University, Faculty of Dentistry, Department of Prosthodontics - Clinic for Temporomandibular Disorders (TMD) with chief complaints of pain and apparent swelling in the left preauricular region. Her medical history revealed no types of macro trauma, but she obviously had both nocturnal and diurnal bruxism. Due to parafunctional activity, the volume of the masseter muscles was increased and the teeth were worn. A smooth firm and mobile swelling which plainly became more evident in the last 6 months was the first symptom that the patient had spotted. The mass was tender to palpation. Maximum mouth opening was painful for the left TMJ. As no sign of muscle tenderness was observed, the pain was solely located to the left TMJ region. The pain level for the left TMJ was 3 (0 = no pain, 1 = mild pain, 2 = moderate pain, 3 = severe pain), where it was 0 for the right TMJ. The present pain was elicited by pressure over the swelling and during movement of the mandible.

Radiographic Investigation

The conventional and open-closed mouth panoramic radiographs presented the bony structures as normal, indicating the lesions were not bone originated. Then open-closed mouth T1 and T2 weighted MRI scans were performed. The MRI scans approved the mass to be a TMJ cyst (Fig. 3, a-c).

Surgery

Surgery was done at the University of Istanbul, Medical Faculty, Department of Plastic and Reconstructive Surgery. 2 cystic lesions were found; 1
lesion was approximately 10 mm in diameter, adjacent to the lateral of the joint capsule, and the other was 3mm in diameter, adjacent to parotid gland. The lesions had no communication with the joint. The cystic lesions were dissected carefully from the capsule completely and excised, preserving their integrity (Fig. 4). Postoperative healing was uneventful. After 15 months of follow-up examination, no recurrence was observed (Fig. 5).

Histopathology

Macroscopic evaluation showed an 11x10x8 mm cyst and a 5x4x2 mm mass (Fig. 6). The cysts surface was light brown and smooth. The consistence was elastic soft, covered by a 1 mm capsule and containing jelly like yellow material. The surface of the mass was grey and smooth, and it was also elastic soft.

The excised tissue was fixed in 10% formalin. The sections were stained with hematoxylin-eosin. Histological evaluation of the 11x10x8 mm lesion showed a cystic structure lined by fibrous tissue. The final diagnosis was a ganglion cyst. The histological evaluation of the smaller mass was reactive hyperplastic lymph node.
Synovial cysts are lined by synovial cells and called as true cysts. They are usually filled with gelatinous fluid and the lining consists of cuboidal or flattened cells consistent with a synovial origin. Synovial cysts may or may not communicate with the joint cavity. Ganglion cysts are lined by fibrous tissue and called as pseudocysts. They may arise from myxoid degeneration and cystic softening of the collagenous tissue of a joint capsule. They are filled with viscous fluid or gelatinous material and do not contain synovial lining cells on histological examination. Ganglion cysts are not connected with the joint cavity.

Discussion

Cysts of the TMJ are rare compared to other joints. They may occur at any age, but are usually seen between the second and fourth decade. Female preponderance is in the ratio of 3:1. The present case was a 48-years-old female.

Usually terms ganglion cyst and synovial cyst have been used interchangeably and are erroneously considered to be synonymous. Although both cysts occur near joints, the histology and the origin of these cysts are different.
joint cavity and are usually seen with diameters ranging between 10-25mm\textsuperscript{1,2,8,12}. In the present case, a ganglion cyst and a reactive hyperplastic lymph node were diagnosed by histological evaluation.

Although the aetiology is unknown, post-traumatic development has been reported for 3 cases\textsuperscript{5,6,11}. Synovial cysts seem to develop by the rupture of the capsule and herniation of the synovial membrane into the parotid parenchyma by the increase of intra-articular pressure due to trauma or inflammation. On the other hand, ganglion cysts develop by mixoid degeneration and cystic softening of the joint capsule\textsuperscript{2,5}. Our patient has history of chronic micro-trauma as a result of nocturnal and diurnal bruxism. Due to parafunctional activity, the volume of the masseter muscles was increased and the teeth were worn. Although our patient had no history of macro-trauma or inflammation, micro-trauma as a result of bruxism might be an etiologic factor.

Diagnosis of a mass located in the preauricular region is very difficult. The differential diagnosis of the mass in this region includes parotid tumours and cysts, tumours of the condyle, cysts of the TMJ, benign cervical lymphoepitelial cysts and benign vascular or neural masses\textsuperscript{1,2,4,12}.

Computerized Tomography (CT) and MRI are the most frequently used diagnostic tools for diagnosis of a preauricular pathology\textsuperscript{2,5,12,13}. McCuirt and Myers\textsuperscript{9} and Farole and Johnson\textsuperscript{4} have reported positive values of using MRI for the diagnosis of synovial and ganglion cysts. Lopes et al\textsuperscript{8} advocated that preoperative use of ultrasound is very helpful to locate and diagnose the swelling. In our case, T1 and T2 weighted MRI scans were performed. T1 weighted images have showed that lesion had heterogeneous low signal intensity and on the T2 weighted image, a homogenous high intensity signal was obtained. MRI findings showed that the mass was a TMJ cyst.

TMJ cysts are usually asymptomatic and patients’ chief complaint was a mass in the preauricular region. There may be pain and obvious deformity. If the operation is not contraindicated treatment is surgical. After incomplete excision, recurrence may be seen\textsuperscript{1,12}. Therefore, in the present case, optimal attention was given to resect the cysts completely.

**Conclusion**

Ganglion cysts are pseudocysts with a fibrous tissue lining. Excision of the presented cyst provided definitive treatment and microscopic examination confirmed the diagnosis. Because of the rare nature, patients who present themselves with somewhat atypical TMJ dysfunction symptoms need a detailed clinical examination and proper imaging to avoid the risk of misdiagnose.

**References**


Correspondence and request for offprints to:
Hanefi Kurt
Istanbul University, Faculty of Dentistry
Department of Prosthodontics
34093 Çapa, Istanbul, Turkey
E-mail: hkurt@istanbul.edu.tr
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