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## CONTENT

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Editorial: Magnification in Dentistry</td>
<td>5</td>
</tr>
<tr>
<td>Seow LL</td>
<td></td>
</tr>
<tr>
<td>Clinical parameters of periodontal abscess: a case series of 14 abscesses</td>
<td>6</td>
</tr>
<tr>
<td>Y K Chan, W S Tien</td>
<td></td>
</tr>
<tr>
<td>Prosthodontic Management Of A Malpositioned Endosseous Implant In The Anterior Maxilla: A Clinical Report</td>
<td>8</td>
</tr>
<tr>
<td>Daylene Jack-Min Leong, Ansgar Chi-Chung Cheng, Elvin Woei-Jian Leong, Tee-Khin Neo, Helena Lee</td>
<td></td>
</tr>
<tr>
<td>Pattern Of Toothpaste Usage In Children Under Six Years Old</td>
<td>14</td>
</tr>
<tr>
<td>S. Nagarajan, Suhairah Jani, Noridawati Mohd Nor</td>
<td></td>
</tr>
<tr>
<td>What Dental Students Think About Fixed Prosthodontics e-Learning (FPeL)</td>
<td>20</td>
</tr>
<tr>
<td>Marlynda A, Natasya AT, Salleh MAM</td>
<td></td>
</tr>
<tr>
<td>Evaluation Of Orthodontic Treatment Outcome: A Self-Audit Using The Peer Assessment Rating (Par) Index</td>
<td>25</td>
</tr>
<tr>
<td>Loke Shuet Toh</td>
<td></td>
</tr>
<tr>
<td>Knowledge Of Prescribing Antimicrobial Among Dental Practitioners In Klang Valley Region</td>
<td>35</td>
</tr>
<tr>
<td>Huda Kh. AbdulKader, Salmiah Mohd Ali, Mohamed Ibrahim Abu Hassan, Mohamed Mansor Manan</td>
<td></td>
</tr>
<tr>
<td>Refining Occlusion With Muscle Balance To Enhance Long-Term Orthodontic Stability</td>
<td>44</td>
</tr>
<tr>
<td>Derek Mahony</td>
<td></td>
</tr>
<tr>
<td>Microleakage Of Class II Cavities Restored Using Composite Resins</td>
<td>52</td>
</tr>
<tr>
<td>Normaliza Ab. Malik, Marhazlinda Binti Jamaludin, Seow Liang Lin</td>
<td></td>
</tr>
<tr>
<td>Instructions to contributors</td>
<td>58</td>
</tr>
</tbody>
</table>
EDITORIAL: MAGNIFICATION IN DENTISTRY

Human being had been described by the great philosopher Tielhard de Chardin as a cerebro-manual creature. However, it is important to appreciate that the hands could not treat what the eyes could not see. It is therefore recognised that the use of magnification in dentistry not only improves the quality of care provided to patients, but also expands the range of treatments that can be offered. Magnification in dentistry can be achieved with either surgical loupes or dental microscopes. Surgical loupes were first used by restorative dentists in America in the 1980s and the American specialist endodontists began integrating dental microscopes into their practice in the mid 1980s. European restorative dentists were made aware of the use of microscope in endodontics at the beginning of 1990s.

There are numerous benefits of incorporating magnification in the practice of dentistry, namely better posture and improved comfort, magnified images, increased precision, better illumination, expansion of treatment options and improved dental care. Ophthalmologists have suggested that while using magnification, the eye muscles become accustomed to contracting to a given level, and they must relax again to regain normal function. To avoid or reduce this challenge, it has been suggested that dental practitioners wearing magnifying loupes should consider not wearing them all of the time; instead, they should use loupes for some procedures that need precision eg. searching for canal orifice, crown preparation, evaluating the fit of a long-span fixed prosthesis and unmagnified, normal vision for other procedures eg. impression taking, extraction.

For the dental practitioners seeking to incorporate magnification into their practice, the choice of equipment can be confusing as there are many choices available in the current market. The dental practitioners need to decide the level of magnification they would like to have. Whilst dental operating microscopes can provide staggering levels of magnification, many routine dental procedures can be performed well with high quality dental loupes. Dental loupes are less expensive, more practical, portable and easier to use in comparison to the dental microscopes; therefore it is an excellent alternative to a microscope for procedures that do not require high level of magnification. It has been recognized that the higher the magnification, the greater detail that can be observed, however viewing field became smaller.

A number of features must be well-thought-out when considering purchasing dental loupes. One of the most critical features is the resolution of the loupes. Resolution is the ability to distinguish one small structure from another. The quality and design of the lenses used in manufacturing the loupes will influence the resolution. The dental practitioners need to understand that some lenses will provide good resolution across a portion but not necessarily the entire viewing field. The resolution can only be determined with trying and comparing different made of dental loupes. It is therefore important to request for a trial period whenever it is possible to determine the performance of the instrument prior to purchasing.

One question that dental practitioners frequently asked is- What level of magnification is needed? The level of magnification depends upon the type of procedure being undertaken and also the size of the person. The taller the practitioner is, generally the higher the magnification should be, since the practitioner’s head is farther from the operating site and the image is smaller. The most popular magnification level is about 2.5 X for an average-sized person and general dental procedures eg. caries removal, crown preparation. For endodontic practice, higher magnification eg. 4.5 X and 6 X may be desired. The use of a clinical microscope at magnification levels up to 20 times (20X) has been shown to improve treatment outcomes in the field of endodontics. However, learning to use the microscope requires time and effort, and the cost of the devices is significant.

Using magnification in the field of dentistry is useful and can improve the quality of care render to patients. Appropriately fitted dental loupes can improve posture during treatment of patients and hence help to reduce occupational related muscle pain in the neck and shoulder. Dental practitioners should be encouraged to consider incorporating magnification in their practice.

Associate Professor Dr. Seow Liang Lin
Editor
Malaysian Dental Journal
Clinical parameters of periodontal abscess: a case series of 14 abscesses

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ABSTRACT
The prevalence of periodontal abscesses in emergency dental clinics was found to be between 8%-14%. The purpose of this study was to study the clinical features of periodontal abscesses seen in a specialist periodontal unit. There were 14 patients with equal distribution of gender. The mean age was 39.6 years. Twelve upper teeth (86%) were found to be involved as compared to two lower teeth (14%). There were more posterior teeth involved, a total of nine teeth (64%) as compared to five anterior teeth (36%). The mean pocket depth associated with the abscesses was found to be 7.4mm. There were ten buccal sites (71%) as compared to four palatal sites (29%). Average temperature of patients was 36.9° C. Only one patient was found to have cervical lymphadenopathy (7%). The teeth involved were found to be mostly mobile with mobility of grade I to III (71%).

Key Words: Periodontal abscess, pocket, periodontitis, clinical features

INTRODUCTION
Periodontal abscess could be defined as a localized purulent infection within the tissue adjacent to the periodontal pocket that may lead to the destruction of periodontal ligaments and alveolar bone.¹ It is classified as one of the three types of abscesses of the periodontium (gingival, periodontal and pericoronal) as described in the new classification of periodontal diseases and conditions by the American Academy of Periodontology.²

The periodontal abscess is the third most frequent dental emergency, and it is prevalent among untreated periodontal patients and periodontal patients during maintenance.³ The prevalence of periodontal abscesses in emergency dental clinics was found to be between 8%-14%.³ There is a paucity of scientific literature on the clinical features of periodontal abscesses.

Herrera D et al.⁴ reported that 62% of abscesses affected untreated periodontitis patients with 69% associated with a molar tooth with bleeding and suppuration. Mean pocket depth was found to be 7.28 mm with 79% presenting with some degree of mobility. Cervical lymphadenopathy was noted in only 10% of patients.

In 2005, Jaramillo A et al.⁵ reported that periodontal abscesses were also associated with ongoing chronic periodontitis, bleeding on probing, suppuration with affected teeth being lower anteriors, upper anteriors and lower molars.

METHODOLOGY
This is a descriptive study of patients with periodontal abscesses that presented at the periodontal unit, Mahmoodiah Government Dental Clinic, Johor Bahru, Malaysia. The data was collected prospectively from November 2006 to November 2007. The clinical parameters recorded included sites, probing pocket depth, mobility, Plaque Index (Silness & Löe 1964), Gingival Index (Löe 1967), presence or absence of cervical lymphadenopathy and temperature.

RESULTS
A total of 14 patients were involved in the study. The mean age was 39.6 ±7.6 years. There was equal distribution of gender with seven male and seven female patients. Ethnic distribution comprises of two ethnic races only, nine Malay patients (64%) and five Chinese patients (36%). Twelve patients were non-smokers (86%), one former smoker (7%) and one current smoker (7%). Seven patients were on supportive periodontal therapy, six were on active periodontal treatment with only one new case.

There were twelve upper teeth and two lower teeth with five anterior teeth (36%), five premolar (36%) and four molars (28%). Probing pocket depth associated with the abscesses was 7.4±1.6 mm. The abscesses were associated with ten buccal sites (71%) as compared to four palatal sites (29%). Most of the teeth involved were mobile (71%) with seven teeth with grade I mobility, two teeth with grade II mobility, one tooth with grade III mobility. Most of the teeth
were vital with eleven teeth vital (79%) and only three teeth was found to be non vital (21%).

The mean temperature recorded was 36.9±0.5 centigrade. There was hardly any involvement of the cervical lymph nodes with only one patient examined having cervical lymphadenopathy.

Overall oral hygiene was quite good with the overall Plaque Index found to be 1.0±0.4. The overall Gingiva Index was found to be 0.9±0.5.

**DISCUSSION**

Periodontal abscess was found to occur more in the middle age group (39.6 ±7.6) with equal distribution of gender in this study. This is important clinically because it is the significant group in terms of productivity with a need to preserve the teeth for many more years to come.

Posterior teeth were found to be more frequently involved in agreement with a previous study 4 but with molars and premolars having equal distribution. This could be due to furcation involvement.

Only one current smoker and one former smoker were among the fourteen patients. This was surprising because smoking is an established risk factor for periodontal disease. It could be due to the fact that half of the patients were females who usually in Malaysia do not smoke or due to the small sample size.

Probing pocket depth was found to be deep (7.4 mm) which was in agreement with Kaldahl et al.6 and Herrera D et al. (7.28 mm). A deeper pocket tends to have a tortuous pathway contributing to bacterial niche not easily accessible to debridement, hence favoring the possible development of an abscess.

Most of the teeth involved had some degree of mobility (71.4%), this was in agreement with a previous study 7. Mobility is most likely a clinical manifestation of severe attachment and bone loss. Most of the teeth involved were found to be vital (79%). This is in agreement with the current view that perio-endo lesion or combined lesion are relatively uncommon, confirming that most of the severe periodontally affected teeth were vital.7

The Plaque Index (1.0) and Gingiva Index scores (0.9) in this study were relatively low. This was surprising but could be due to the fact that the majority of patients involved are in active or supportive phase of periodontal treatments thus having improved oral hygiene resulting in lower plaque accumulation and inflammation.

There were hardly any systemic involvements with only one patient having cervical lymphadenopathy (7%) in agreement with a previous study 4 that found only 10% having lymphadenopathy.

The majority of the patients were afrebile with a mean temperature of 36.9 centigrade suggesting that periodontal abscess rarely causes systemic signs and symptoms.

**CONCLUSION**

Upper, posterior teeth and buccal sites were found to be more likely affected by periodontal abscesses. Periodontal abscesses were found to be associated with deep pockets more than 6 mm. Systemic involvement was minimal with most patients found to be afrebile and without any cervical lymphadenopathy.

Further studies with a bigger sample sizes would be needed to confirm this preliminary findings.

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**REFERENCES**

ABSTRACT
Restoration of anterior teeth with implant-supported crowns is a technique-sensitive procedure. Despite careful treatment planning, malpositioned implants is not uncommon. Several techniques have been described to prosthodontically compensate for improperly inclined implants. The following clinical report describes and illustrates an alternative technique for the prosthodontic management of a malpositioned endosseous implant in the anterior maxilla.

Key Words: Malpositioned implants, anterior maxilla, prosthodontic management

INTRODUCTION
Restoration of anterior teeth with implant-supported crowns is a technique-sensitive procedure and it is one of the challenges for the surgical-restorative team. Factors that directly affect clinical outcomes include the quantity and quality of available alveolar residual ridge, correct positioning of the implant dimensionally, the soft tissue biotype, the selection of the implant abutment, the provisional restoration and the fabrication of the definitive crown.

The amount of available bone is one of the critical factors determining the ultimate success of the implant. Sufficient facial bone thickness and height is critical for long term stability of gingival margins around implants and adjacent teeth, preventing buccal recession and exposure of the implant. Studies have shown that 1.8 mm of buccal bone thickness or at least a width of 2 mm buccal wall is required to maintain the alveolar bone level at the implant platform and prevent bone loss in that area.

Besides buccal bone thickness, sufficient interproximal bone height of the teeth adjacent to the implant is also necessary as it influences the height of the peri-implant papillae. Studies have shown that a distance of 4-5 mm from the alveolar crest to the contact point would maximize esthetics through maintaining an intact interdental papilla.

Correct positioning of the implant in a 3-dimensional manner is another key factor that contributes to the success of the restoration. Apical positioning of the implant is required to mask the metal of the implant and abutment. It is generally accepted that the more apical the placement of the implant, the better the emergence profile. However, placing the implant-abutment surface more apically also means losing more crestal bone for establishing the peri-implant biologic width. The implant shoulder should ideally be located approximately 2 mm apical to the midfacial gingival margin of the planned restoration. This allows for 3 mm of soft tissue emergence on the direct labial surface of the implant. It is generally recommended to position the implant 1.5 to 3 mm below the cementoenamel junction (CEJ) of the adjacent teeth for optimal implant esthetics.

Soft tissue factors also influence the ultimate treatment outcome. One of which is the presence of adequate keratinize gingiva. Although keratinized tissue is not mandatory for implant placement, it has been shown to be preferable in the esthetic zone to ensure tissue stability and to improve esthetics. This taken in consideration with the patient’s gingival biotype will partly determine the risk for postsurgical recession as the patient’s biotype would determine how the
periodontium responds to implant placement, thus affecting the esthetic outcome.

It has been found that thick biotypes characterized by dense fibrotic tissue, a thick band of keratinized gingiva and a lack of scalloping between the interdental papilla and buccal gingiva would pose less of a challenge in attaining a desirable esthetic response. A thick gingival biotype is more resistant to trauma from surgical or restorative procedures and tends to respond to insult by pocket formation instead of recession and keratinized gingiva is usually abundant. A thin gingival biotype characterized by thin, delicate soft tissue, minimal keratinized gingiva and pronounced soft-tissue scalloping would be more prone to esthetic failure as the tissue would respond to periodontal insult by recession. A gingival thickness ≥1.5 mm and width of keratinized gingiva ≥2 mm has been reported as the soft tissue characteristics for predictable esthetic implant placement.

Incorrect implant placement may therefore complicate the restorative treatment process and may compromise the esthetic outcome. Recent technology have allowed more predictable placement of endosseous implants but malposition of endosseous implants is still not uncommon.

Several techniques have been described to prosthodontically compensate for improperly inclined implants. The following clinical report describes an alternative technique for the prosthodontic management of an unfavorable implant position.

CLINICAL REPORT

A 30 year-old healthy Chinese female who is a non-smoker presented with a missing left maxillary central incisor. Pre-operative examination revealed a crest width of more than 2 mm and sufficient ridge height with no signs of facial bone atrophy. More than 2 mm of keratinized gingiva on the facial aspect of the upper anterior teeth was also present and the patient had a moderately thick gingiva biotype. Smile analysis revealed a medium smile line.

Orthodontic treatment was carried out to obtain the desired mesiodistal width, alignment and incisor overlap for the replacement of the left central incisor (Fig. 1). After initial insertion of the implant, a composite resin pontic was bonded to the adjacent maxillary incisor to serve as a provisional restoration (Fig. 2).

At second stage surgery, the composite resin pontic was removed and a soft tissue flap was raised to expose the implant. Placement of the implant was found to be excessively inclined towards the buccal direction (Fig. 3). An implant level definitive impression was made and the composite resin pontic was rebonded to the adjacent maxillary central incisor.

Fig. 1: OPG during orthodontic treatment prior to implant placement

Fig. 2: OPG of bonded composite resin pontic as provisional after implant placement

Fig. 3: Implant placement excessively inclined towards the buccal
An implant level burn out type abutment was selected (UCLA abutment, Implant Innovation Corp.). A full contour sculpture of the tooth was fabricated using acrylic resin (Fig. 4) (Pattern Resin, GC America, Chicago, Ill.). The pattern was cutback 1.5 mm for the development of a full ceramic crown. The acrylic resin pattern was subsequently casted in type III gold alloy (Degulor C, Degussa, Hanau, Germany) (Fig. 5). A provisional restoration was made using a bis-acrylic composite material (Luxatemp, DMG, Hamburg, Germany).

Fig. 4: Full contour sculpture of tooth fabricated using acrylic resin

Fig. 5: Custom abutment casted in type III yellow gold

The custom abutment was autoclaved and it was inserted on the implant after a flap was raised. The abutment was torqued down to 35Ncm. The labially positioned abutment screw access hole was filled up with gutta-percha and composite resin material (Z100, 3M, St. Paul, MN) (Fig. 6). The provisional crown was inserted using provisional cement (Tempbond NE, Kerr, Romulus, MI) (Fig. 7). The implant site was allowed to heal for 6 months before the fabrication of the definitive restoration. 6 months later, the provisional crown was replaced with a definitive full ceramic crown (Fig. 8-11).

Fig. 6: Abutment screw access hole was filled up with gutta-percha and composite resin material

Fig. 7: Post-cementation of provisional crown

Fig. 8: Post-cementation of definitive all-ceramic crown

Fig. 9: Post-operative frontal view of patient’s smile
DISCUSSION

Improperly inclined implants can lead to more technically demanding prosthodontic management. To compensate for the potential esthetic complication with the misangulated implant, several measures were undertaken.

From the surgical aspect, the crestal incision at stage II surgery to expose the implant was located approximately 2 to 3 mm towards the palatal aspect and extended through the sulcus of the adjacent incisor teeth to the facial aspect of the alveolar crest. Such incision design avoids the formation of scar tissue in the midcrestal area and ensures sufficient vascularity of the buccal flap in the area of the future papillae. Bone augmentation was not carried out in this patient as more than 2 mm of buccal bone thickness was present at implant placement.

Fig. 10: OPG of implant with definitive PFM crown

Fig. 11: PA xray of implant with definitive PFM crown

From the prosthetic aspect, duration of provisionalization was stretched over 6 months. The definitive abutment was torqued down and a provisional crown placed for 6 months. This would allow for the establishment of soft-tissue contour and optimize gingival esthetics. The crown was also fabricated with a long interproximal contact area to ensure a contact-to-alveolar bone distance of not more than 5 mm, which managed to support the interproximal papillae during the issue visit.

Although the implant was excessively inclined towards the buccal, the implant shoulder measures approximately 4 mm below the CEJ of the adjacent incisors, which contributed to a more favorable emergence profile. To promote implant integration, a fixed restoration bonded to the adjacent incisor teeth was the provisional of choice after implant insertion, to avoid placing any pressure on the implant healing cap. Gold alloy was the material of choice for the custom abutment because a cast metal abutment can be easily shaped to the desired definitive contour, for optimal retention and resistance form, and thickness of the ceramic crown. The cast metal abutment can also be easily contoured to replicate the emergence profile established by the provisional restoration, to enhance the overall esthetic outcome of the all-ceramic crown.

Working in our favor in this case was also the patient’s soft tissue biotype. Having a moderately thick gingiva biotype and adequate width of keratinized gingiva of more than 2 mm lowers the patient’s risk of gingival recession and a poorer esthetic outcome. Furthermore, the patient has a medium smile line, which is an advantage because patients with a high lip line will show more tissue and reveal any unesthetic aspects of the peri-implant tissue.

Despite the reasonably successful restoration of the misangulated implant in this report, long-term follow-up appointments would be necessary to monitor for potential peri-implant bone loss, soft tissue recession and/or formation of periodontal pockets especially at the labial aspect where composite resin was placed at the screw access hole. It must also be stressed to the patient the importance of a meticulous oral hygiene maintenance regime, in order to increase the long-term success of the implant restoration.

SUMMARY

Despite careful treatment planning, malpositioned or unfavourable inclination of implants is not uncommon. A relatively inexpensive and simple clinical solution has been presented and illustrated.
REFERENCES


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ABSTRACT

Objectives: To assess pattern of toothpaste usage among young children under 6 years old.

Materials and methods: This was a cross-sectional descriptive study carried out at the Faculty of Dentistry, Universiti Kebangsaan Malaysia. Parents of children below 6 years old were involved. 200 questionnaires were distributed and 136 (68%) were returned for analysis. The questionnaire covered the following parameters: type, frequency, and quantity of toothpaste usage among children, level of parental knowledge of fluoride concentration in toothpaste and selection criteria of suitable toothpaste for their children.

Results: Majority of the respondents (83.1%) said they used children's toothpaste to brush their child's teeth and 62.5 % of them knew that the toothpaste used had fluoride in it. Slightly more than half of the respondents (53.7%) said they started brushing their child's teeth one year after eruption of the first tooth. Almost an equal proportion of the respondents reported using toothpaste twice daily (50.7%) and only 44.1% of them supervised their children's brushing. Respondents generally used more than a pea-sized toothpaste quantity (53.6%). Taste, fluoride concentration and brand of the toothpaste appeared to be the main criteria that influenced the selection of the toothpaste (55.9%). Income and educational levels of the respondents did not influence the type of toothpaste used.

Conclusion: These findings indicated that although parents were brushing their children's teeth with children toothpaste, they were still unaware of the proper usage and importance of fluoridated toothpaste.

Key Words: Toothpaste, Fluoride, Pattern

INTRODUCTION

Toothbrushing is an aid for oral hygiene care. Effective brushing with selected toothpaste helps to remove dental plaque that contributes to dental caries. There are many types of toothpaste available in the market in Malaysia1. Generally the type, frequency and quantity of toothpaste used by children are based purely on parental preference.

Children below the age of six are often closely scrutinised in many dental researches especially in relation to usage of fluoridated toothpaste2,3. Over the years, overzealous usage of fluoride has been linked to dental fluorosis4. Accidental ingestion of fluoridated toothpaste is said to be one of the main contributing factor of dental fluorosis5. Children between the ages of 15 and 30 months are most at risk to develop dental fluorosis especially to the anterior teeth6,7. Numerous guidelines have been published regarding the usage of fluoridated toothpaste in dentistry8,9. It is not clear how fluoridated toothpaste is used among young children in an urban population.

The aim of this study is to assess parental pattern of toothpaste usage among young children under six years old in an urban setting.

MATERIALS AND METHODS

This was a cross-sectional descriptive study involving parents of children below 6 year old attending for treatment at the Universiti Kebangsaan Malaysia (UKM) Dental Faculty. The selection of the participants for this study was based on the following inclusion criteria:

- Parents who have one or more children below 6 years of age.
- Parents having children with one or more teeth.
- Parents able to understand the purposes, risks and benefits of this study.
- Parents able to give a written consent if needed.

Parents with significant cognitive impairment who were unable to give informed consent and who were unable to read or write in either Bahasa Melayu or English language were excluded from this study.

Verbal and written information of the study were also given to the selected parents prior to the study. The parents had to answer a questionnaire that was
given to them. The questionnaire has two parts; Part A and Part B. Part A was related to questions pertaining to personal demographic details of the parents or guardians, and Part B focused on information related to patterns of toothbrushing and toothpaste usage among children below 6 years old and the level of parental knowledge on their children’s oral health care.

The questionnaire was pretested to assess the suitability of the questionnaire design on 10 selected individuals. Some corrections to the main questionnaire were made based on the evaluation of the baseline information gathered.

This study was approved by the ethics committee of the Faculty of Dentistry, Universiti Kebangsaan Malaysia (UKM).

Data collected, was computed and statistically analysed using SPSS Version 14 Statistical Software.

RESULTS

A total of 200 questionnaires were distributed to the parents through student clinicians. Of the 200 questionnaires, 152 were returned giving a response rate of 76%. During the data analysis stage, a further 16 questionnaires were rejected because of incomplete information. In all, only 136 questionnaires (68%) were used in the statistical analysis. Of the 136 respondents, 94.7% (n=130) of them had undergone secondary or tertiary level of education. When the income levels of the parents were compared, 77.2% (n=105) of them earned more than RM 1000 a month.

To the question as “to when they started using toothpaste to brush their child’s teeth”, slightly more than half of the respondents reported it to be few months to a year after eruption of the first tooth (54.4 %). Almost a quarter of the overall respondents (24.3%) also said they only started using toothpaste to brush their child’s teeth with toothpaste more than a year after the eruption of the first tooth (Table 1).

The majority of the respondents (83.1%) said they used children toothpaste to brush their children’s teeth. Usage of herbal toothpaste for brushing in this surveyed group is negligible (0.7%). However, there were still a small proportion of respondents (16.2%) in our survey who were still using adult toothpaste (Table 1).

### Table 1: Toothbrushing practices and knowledge of toothpaste used

<table>
<thead>
<tr>
<th>ITEM</th>
<th>RESPONSES (n)</th>
<th>PERCENTAGE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commencing time of toothbrushing with toothpaste after eruption of first primary tooth</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Immediately after eruption</td>
<td>29</td>
<td>21.3</td>
</tr>
<tr>
<td>Few months to a year after eruption</td>
<td>34</td>
<td>25.0</td>
</tr>
<tr>
<td>More than one year after eruption</td>
<td>73</td>
<td>53.7</td>
</tr>
<tr>
<td><strong>Type of toothpaste used</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Children’s toothpaste</td>
<td>113</td>
<td>83.1</td>
</tr>
<tr>
<td>Adult’s toothpaste</td>
<td>22</td>
<td>16.2</td>
</tr>
<tr>
<td>Herbal or other toothpastes</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td><strong>Aware of fluoride presence in the toothpaste used</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aware</td>
<td>85</td>
<td>62.5</td>
</tr>
<tr>
<td>Not aware</td>
<td>15</td>
<td>11.0</td>
</tr>
<tr>
<td>Not sure</td>
<td>36</td>
<td>26.5</td>
</tr>
<tr>
<td><strong>No of times toothpaste used for toothbrushing per day</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>once</td>
<td>49</td>
<td>36.0</td>
</tr>
<tr>
<td>Twice</td>
<td>69</td>
<td>50.7</td>
</tr>
<tr>
<td>More than twice</td>
<td>18</td>
<td>13.2</td>
</tr>
<tr>
<td><strong>Quantity of toothpaste placed on toothbrush brittles during toothbrushing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pea-sized</td>
<td>63</td>
<td>46.3</td>
</tr>
<tr>
<td>Half-length</td>
<td>49</td>
<td>36.0</td>
</tr>
<tr>
<td>Entire length</td>
<td>24</td>
<td>17.6</td>
</tr>
<tr>
<td><strong>Supervised toothbrushing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not supervised</td>
<td>76</td>
<td>55.9</td>
</tr>
<tr>
<td>Supervised</td>
<td>60</td>
<td>44.1</td>
</tr>
<tr>
<td><strong>Immediate post toothbrushing behaviour</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rinse with plenty of water and spit out</td>
<td>106</td>
<td>78.0</td>
</tr>
<tr>
<td>Spit out without rinsing</td>
<td>15</td>
<td>11.0</td>
</tr>
<tr>
<td>Swallow toothpaste</td>
<td>15</td>
<td>11.0</td>
</tr>
</tbody>
</table>
Almost two thirds of the respondents (62.5%) said they knew that the toothpaste used to brush their children teeth contain fluoride in it. There was still a significant percentage of parents (37.5%) who were still not sure or do not know of the presence fluoride in the toothpaste used (Table 2).

Table 2: Main criteria for selection of toothpaste for children by parents

<table>
<thead>
<tr>
<th>CRITERIA</th>
<th>RESPONSES (n)</th>
<th>PERCENTAGE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>26</td>
<td>9.6</td>
</tr>
<tr>
<td>Brand</td>
<td>44</td>
<td>16.2</td>
</tr>
<tr>
<td>Taste</td>
<td>108</td>
<td>39.7</td>
</tr>
<tr>
<td>Colourful Packaging</td>
<td>14</td>
<td>5.2</td>
</tr>
<tr>
<td>Fluoride concentration</td>
<td>22</td>
<td>20.6</td>
</tr>
<tr>
<td>Recommended by others</td>
<td>16</td>
<td>5.9</td>
</tr>
<tr>
<td>Based on believes</td>
<td>8</td>
<td>2.9</td>
</tr>
<tr>
<td><strong>Total responses</strong></td>
<td><strong>272</strong></td>
<td><strong>100.00</strong></td>
</tr>
</tbody>
</table>

*Two selection criteria were recorded for each respondent

All the respondents claimed that their children carried toothbrushing with toothpaste daily. Nearly two thirds of the respondents (63.9%) reported using toothpaste twice or more daily when brushing their children’s teeth (Table 3).

Table 3: Type of toothpaste used with various educational levels

<table>
<thead>
<tr>
<th>EDUCATION LEVEL</th>
<th>TYPE OF TOOTHPASTE</th>
<th>PRIMARY EDUCATION (n=6)</th>
<th>SECONDARY EDUCATION (n=69)</th>
<th>TERTIARY EDUCATION (n=61)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult</td>
<td>Adult</td>
<td>0(0%)</td>
<td>10(14.5%)</td>
<td>12(19.7%)</td>
</tr>
<tr>
<td>Children</td>
<td>Adult</td>
<td>6 (100%)</td>
<td>58(84.1%)</td>
<td>49(80.3%)</td>
</tr>
<tr>
<td>Herbal / others</td>
<td>Herbal / others</td>
<td>0(0%)</td>
<td>1(1.4%)</td>
<td>0(0%)</td>
</tr>
</tbody>
</table>

Regarding quantity of toothpaste used for brushing, 46.3% respondents said they placed only a pea-sized toothpaste quantity. Slightly more than half of the respondents (53.6%) said the quantity of toothpaste used was of half length or entire length of the toothbrush bristles (Table 1).

Only 32.4% of the respondents surveyed said they supervised their children's toothbrushing. Slightly more than half of respondents (55.9%) said their children brushed their teeth without any supervision (Table 1).

More than two thirds of the respondents (77.9%) said their children rinsed mouth with plenty of water and spit it out after brushing. A small proportion of the respondents (11%) said their children swallow toothpaste during brushing (Table 1).

When the respondents were asked to select two main factors that they would take into consideration when buying toothpaste for their children, majority of them have selected taste (39.7%), fluoride concentration (20.6%) and brand (16.9%) of the toothpaste as their primary reasons (Table 2).

When the respondents educational and income levels were analysed with reference to the type of toothpaste used, the results showed there were no obvious differences (Table 3 and 4). Majority of respondents used children toothpaste regardless of either their educational background or earning capacity.

Table 4: Type of toothpaste used with various income levels

<table>
<thead>
<tr>
<th>INCOME LEVEL</th>
<th>TYPE OF TOOTHPASTE</th>
<th>&gt;RM1000 (n=31)</th>
<th>RM1000-3000 (n=63)</th>
<th>&gt;RM3000 (n=42)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult</td>
<td>2(6.5%)</td>
<td>16(25.4)</td>
<td>4(9.5%)</td>
<td></td>
</tr>
<tr>
<td>Children</td>
<td>29(93.5%)</td>
<td>47(74.6%)</td>
<td>37(88.1%)</td>
<td></td>
</tr>
<tr>
<td>Herbal / others</td>
<td>0(0%)</td>
<td>0(0%)</td>
<td>1(2.4%)</td>
<td></td>
</tr>
</tbody>
</table>

DISCUSSIONS

Questionnaires are commonly used as an important tool to evaluate and determine patients' knowledge, attitudes and practices, although they may have their limitations. In this study sample, the response rate to the questionnaires that were distributed to the respondents was 76%. Demographic analysis on the income and educational levels of the respondents showed that two thirds (77.2%) of them were earning a minimum wage of above RM 1000 and 95.6% of them had obtained education beyond the secondary level respectively. This sample may be reflective of an urban population such as in Kuala Lumpur in terms of income and educational heights.

Based on this study, more than half of the respondents (53.7%) said they only started brushing their children’s teeth with toothpaste between few months and a year after eruption of the first tooth. This shows that most respondents were unaware about the exact timing to start using toothpaste to brush their children’s teeth. The available recommendations indicate that plaque removal should be carried with either washcloth or a soft, small headed toothbrush in a combination with smear layer of children’s fluoridated toothpaste as the child's first tooth erupts 9,10,11. However, one has to bear in mind that not all children are able to tolerate the presence of
toothbrush or toothpaste in their mouth. This may be a reason why respondents (78.7%) in the present study did not commence early toothbrushing besides the unawareness of the actual timing to commence toothbrushing in children. We believe that oral hygiene care should begin as early as 3 months into infancy well before the first primary tooth erupt where the gums of the teeth bearing areas should be wiped gently using water with gauze or cotton. Thereafter, early introduction to toothbrushing activity such as using soft finger tip toothbrushing aid either dipped in warm water or with smear layer of fluoridated children’s toothpaste if the child can tolerate should commence as soon as the first tooth starts to erupt. This process which begins in early infancy may be a useful aid in providing a learning curve for a child to accustom to toothbrushing with toothbrush and toothpaste as it grows older.

When questioned about the type of toothpaste used to brush their children’s teeth, most of the respondents (83.1%) said they used children’s toothpaste. This is in line with the European Academy of Paediatric Dentistry (EAPD)9 and American Academy of Pediatric Dentistry (AAPD)10 recommendations, which suggested that children below the age of six should used children toothpastes with low fluoride concentration (less than 500 ppm). However, one has to be cautious when selecting an appropriate children’s toothpaste as not all children toothpastes marketed has fluoride in them. Some even may have a higher than the recommended concentration of fluoride. Of late there is also a growing dilemma against early use of fluoride toothpaste in infants below the age of two. There are two schools of thought on this issue; one argues that children below the age of two are at higher risk for enamel fluorosis than children who begin to use fluoride toothpaste later or not at all12-15. Therefore, it recommends use of gauze and water or non fluoride toothpaste for cleaning of infant’s teeth. Another school claim’s use of smear layer children’s fluoride toothpaste may be beneficial in preventing caries. One cannot deny the role of fluoride in caries prevention and this has been proven clinically through various studies16. Therefore, recommendations by EAPD9 and AAPD10 on fluoride toothpaste usage in children below 6 years old should be used as a guide until it’s proven otherwise.

Although majority of respondents (83.1%) have indicated they were using children’s toothpaste, only 62.5% of them knew that fluoride was present in the toothpastes that they were using. These findings indicate that some of the respondents were using children’s toothpaste even without realising it has fluoride in it or not. It is likely that many of the respondents were using fluoridated toothpaste for their children without knowing of its clinical importance in relation to dental health. Although majority of respondents (95.5%) in this study were educated above the secondary level, much is still needed to be done to increase the awareness of fluoride role in caries prevention. Besides emphasis on fluoride anti-caries action, one should also focus on educating the public on what are the ill-effects of fluoride if taken excessively. This is very important to ensure preventive and remedial steps can be instituted to prevent untoward incidents of fluoride overdose that may be detrimental to health17.

The present study also showed that herbal-based toothpastes were not very popular among respondents (0.7%). This is probably due to the taste of the toothpaste which may not be to the liking of small children. Religious sentiment or belief also does not seem to be a major determinant when it comes to selection of children toothpaste.

All the respondents in the present study said they used toothpaste to brush their children’s teeth. About half of the respondents (50.7%) said they used toothpaste twice daily to brush their children’s teeth. This is in line with the finding by Tay and Jaafar (2008)18 where 47.2% of children in their study sample were brushing their teeth twice daily. A small proportion of respondents (13.2%) in the present study said they used toothpaste to brush their children’s teeth more than twice daily. The frequency of brushing often varies from one person to another. Most people brush their teeth at least once daily as a norm. However, toothbrushing twice daily with fluoridated toothpaste is a common practice often recommended as a routine. It is not very clear whether increasing the toothbrushing more than twice daily will result in lower dental caries experience. However, multiple toothbrushing episodes each day probably can result in ingestion of excess fluoride especially in children19. When focusing on toothbrushing, one should not ignore the fact that effectiveness of toothbrushing is much more important than frequency of toothbrushing.

Children below the age of six have poorly coordinated swallowing reflex and also unable to expectorate oral content effectively20,21. This may lead to high probability of accidental swallowing of large quantities of toothpaste per day if the amount used is not monitored, more so if they are using fluoridated toothpaste. When the respondents in this study were asked on the amount of toothpaste used to brush their children’s teeth, 53.6% of the parents said they use more than half the length of the toothbrush bristles. Only 46.3% of the respondents said they used a pea-sized toothpaste quantity for brushing. This is similar to an earlier study conducted by Amdah & Jaafar 22 who reported only 40% of children used the recommended “pea-sized” shape toothpaste volume. The quantity of toothpaste placed onto the bristles of the toothbrush is very essential to prevent the excessive intake of the fluoride by the children.

Young children below the age of six were also reported to swallow a mean of 0.3 g of toothpaste per brushing and this can inadvertently swallow as much
as 0.8 g in a day. This is why children below the age of six were advised to use low fluoride toothpaste and controlled quantity of toothpaste in order to gain maximum benefit anti-caries activity and to prevent accidental ingestion of fluoride. The findings of this study showed lack of knowledge of respondents on quantity of toothpaste that should be used. It is prudent to suggest that children between 6 months to 2 years of age should use small smear of low fluoride toothpaste to clean the teeth. While children between 2 and 6 years old should use a pea sized quantity of less than 500 ppm of fluoride containing toothpaste, unless it is recommended otherwise by their dentists as outlined in the EAPD9 and AAPD10 recommendations. More than half of the children (55.9%) in this study were brushing their own teeth without any supervision. This is similar to the studies conducted by Amdah & Jaafar (2000) and Tay & Jaafar (2008), where most of the parents or guardians did not supervise their children's brushing regularly. Young children usually lack the fine manual dexterity to carry out brushing effectively and also inability to expectorate, parents must ensure that they supervise their children's tooth-brushing or brush their toddler’s teeth, especially by standing or kneeling behind the child in front of the sink or mirror. This is important to in order to avoid over ingestion of toothpaste and to make sure that their children's teeth are effectively cleansed.

In this study only a small proportion of the respondents (11%) said that their children swallowed toothpaste during brushing. This is indeed a good practice as it minimises the amount of toothpaste swallowed. However, one has to interpret this finding with caution because about half of the respondents (55.9%) said that they did not supervise their children's toothbrushing. In order to reap the beneficial effect of fluoride in caries prevention, one has to ensure continues presence of fluoride orally for considerable period for it to assert its effect on the teeth. Majority of respondents (78%) in this study said their children rinsed with a lot of water and spit out after toothbrushing and this may not be a good practice as it tends to wash away the fluoride needed for caries prevention activity. Therefore, children’s below the age of six should be encouraged to either rinse briefly with a small amount of water or spit out the oral content without rinsing in order to retain more fluoride in the mouth.

Taste, fluoride and brand of the toothpaste appeared to be the three main determinants for parents to select the toothpaste of their choice. These findings suggested that fluoride concentration is not the primary determinant for selection of toothpaste, although majority of the respondents (83.1%) in this survey said they were using children’s toothpaste which generally contains less than 500 ppm fluoride. One has to be careful about using taste as the primary criteria for toothpaste selection, as in one hand it encourages children to brush their teeth and in another it increases the risk of fluoride ingestion. One reassuring aspect of the present study is that the respondents also considered fluoride concentration in the toothpaste as one of the criteria for toothpaste selection.

When income and educational levels of the respondents were compared with the type of toothpaste used, the majority of them use children toothpaste for brushing and there are no obvious disparities between the groups. This shows that education and income levels do play a role for good oral hygiene care in our society.

Based on the findings of this study, it appears that the general public is still much unaware of the proper guideline on the selection and usage of the toothpastes in children. There is much needed to be done to improve the knowledge, attitude and practices of oral health our general public. In relation to oral hygiene of care of young children, greater emphasis should be directed towards educating the ante-natal mothers, in order to prepare them psychologically to face the challenges of oral healthcare that they may encounter later on their children.

CONCLUSION

Although most respondents in this study were using children toothpaste for toothbrushing, a significant proportion of them were not practicing the recommended steps on toothpaste usage. However, these findings need to be substantiated with a larger representative sample especially comparing the knowledge, attitude and practices between urban and rural populations.

ACKNOWLEDGEMENT

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REFERENCES

18. Tay HL and Jaafar N. Mothers’ knowledge of fluoride toothpaste usage by their preschool children
ABSTRACT

Introduction: Nowadays, there is a worldwide trend for universities to utilize the benefits of e-learning as a mechanism to facilitate improvements in teaching and learning. Purpose: The aim of this study is to evaluate the effectiveness of using e-learning in the teaching of fixed prosthodontic course i.e. FPeL. Materials and Methods: This was a retrospective analysis of questionnaire data, collected from fourth and fifth year dental undergraduates at the Faculty of Dentistry, National University of Malaysia (Universiti Kebangsaan Malaysia, UKM). For fixed prosthodontics (FP), all students had received a series of traditional classroom lectures, seminars, video demonstration, preclinical and Fixed Prosthodontics e-Learning or FPeL in semester 1 and 2 during their 4th year. The questionnaire of 4 sections was administered after the students completed fixed prosthodontics course. Results: Questionnaires were returned by 136 students (80.9% response rate). Unfortunately, the response rate dropped 12.4% when only 115 students accessed and used the FPeL (68.5%). Majority of FPeL users felt PfeL was beneficial to their learning in the fixed prosthodontic course. FPeL users recommended printable version with detailed explanations, illustrated with more photos and with addition of references. Conclusions: FPeL assisted users in the learning process of fixed prosthodontics.

Key Words: Fixed prosthodontics, e-learning, online, satisfaction level, internet

INTRODUCTION

Nowadays, revolution in information technology utilizing internet as a medium of communication has been an important changes in our daily life. Further more, internet is a medium of communication via discussion forums, audio or video conference and realtime chatting. Many learning institutions and organizations have implemented online courses. Dentistry is also experiencing the increasing demand for online courses. This technology is becoming more popular due to several advantages. However, there are still pros and cons of usage of e-learning as a learning medium.

Learning is the act or process of developing skill or knowledge. However, e-Learning is defined by Joint Information Systems Committee (JISC) as learning facilitated and supported through the use of information and communications technology (ICT). E-learning includes delivery of courses; on-line assessment; student to student and student to teacher communications; use of internet resources; and other learning activities involving ICT and the Internet. E-learning can be in the form of Virtual Learning Environments, Websites, Communications, WebCT, Computer Assisted Assessment (CAA), Computer modelling & visualization, Specialist software, Video conferencing and many more.

The increased use of internet-based or online technologies as supplementary or sole modes of teaching is beginning to spread extensively. This challenged the conventional way of learning strategies such as lecture based, live video demonstration, group discussion and many more. Learners today have come to expect more from their classroom experience, preferring an active role, as compared with the passive style of “learning by lecture.” Pintauro stated that Web-Based Learning (WBI) environments can broaden the educational opportunities offered to learners by providing them with an independent, self-paced, and flexible learning experience. This group reported that WBI is as effective as lecture-based method for teaching a college-level course on Food Safety and Regulation and that the combination of lecture and WBI is significantly more effective than lecture-based or WBI alone. This study was supported by a few earlier studies.

Today, internet resource of dental information can be as good as traditional library. Most universities, associations, companies and some private practices
now have their own website. The website/homepage usually consists of information on their company and its related detail as well as items of educational values such as online scientific journals, personal/private opinions, lecture notes, quizzes and assessments and at a more advanced level, it includes usually video demonstration or simulation. Most of the internet resources are available free but some requires registration to obtain username and password for security purpose.

Downes in 2007 classified these dental internet resources into ten categories. 11
1. Main dental disciplines.
2. Dental and medical organisations.
3. Dental universities.
4. Dental and medical journals.
5. Dental companies.
6. Dental care professions.
7. Dental study/research.
8. Dental link sites.
10. Patient resources.

Educational researches have acknowledged a number of changes to the learning experience since e-learning was introduced into the curriculum. In UKM, Prosthodontics Department had utilized Fixed Prosthodontics E-Learning or FPeL for its fixed prosthodontics course since 2006. Fixed prosthodontics was introduced to the 4th year dental undergraduates at the beginning of the 1st semester. The objective of this study was to evaluate the relative effectiveness of FPeL. The outcome measures are to

1. determine the number of students who had used FPeL
2. determine the effectiveness and helpfulness of features included in FPeL
3. determine the students’ problems while using FPeL
4. gather valuable information for future changes and improvements.

MATERIALS AND METHODS

Respondents
The 4th and 5th year dental undergraduates of Faculty of Dentistry UKM were asked to participate in this study. All students had received a series of traditional classroom lectures, seminars, video demonstration, preclinical and Fixed Prosthodontics e-Learning courseware or FPeL in semester 1 and 2 during 4th year.

Fixed Prosthodontics e-Learning (FPeL) Courseware
FPeL courseware is a simple e-learning course material for fixed prosthodontics. It encompasses only didactic materials. Quizzes, grades, glossary, hyperlink, email, chat room, audio and video are not available. FPeL is supported by Power Point Presentation and Macromedia Flash document. The two-dimensional representation enabled graphic visualisation of each procedure. The images were shot using Nikon Digital Camera and manipulated using Adobe Photoshop 7.0 (Adobe System Inc). The completed FPeL can be accessed on Prosthodontic Department web server at the Faculty of Dentistry, Universiti Kebangsaan Malaysia. No password is required; thus it is accessible by public as well.

FPeL Courseware provides student with an online web course materials. Lecturers will use this avenue to publish the course contents and materials. Lecturers will publish the contents of courseware on the web and student can access the web courseware anywhere and anytime.

Questionnaire
The questionnaire (structured multiple choice and open-ended questions) of 4 sections was administered after the students completed their fixed prosthodontic course. The 1st section consists of demographic data such as academic year and gender that will allow us to look for systematic differences among students based on demographic factors. The 2nd section contains questions on internet access. Here, information on the different types of processor, modem’s speed, surfing time as well as availability of computer for students who used campus’s computer was gathered. The 2nd section is also sought for the information on student’s computer skills. The Likert Scale was used for extracting information regarding the didactic contents was part of 3rd section. Section 4 is on students’ evaluation and satisfaction on FPeL. The questionnaire ended with open-ended questions for comments and suggestions.

Data Analysis
The data were processed and analyzed by means of the Statistical Package for the Social Sciences (SPSS version 12.0).

RESULTS AND DISCUSSION

A. Users Background
An overall response rate of 80.9 % (136 out of 168) was obtained. The response rate for Year 5 was 75.9 % (n=79, 79 out of 104) while for Year 4 was 89.1 % (n=57, 57 out of 64). From 136 respondents, only 22 (16.2%) were males and majority 114 (83.8%) of the respondents were females, reflecting the gender distribution of students in the faculty. Approximately half of the respondents (47.1%) categorized themselves as internet surfers. Out of 136 respondents, 84.6% of them accessed and used the FPeL. Therefore, only 115 respondents can proceed with the rest of questionnaire resulting in 68.5% response rate.
B. **Access and skill**

Of 115 respondents, majority of them (75.7%) accessed the internet from computers on campus while 28 (24.3%) primarily accessed the internet from outside the campus such as cyber cafe. Fifty seven (49.6%) respondents accessed the internet during daytime, 47 (40.9%) used the internet only in the evening and 11 (9.6%) accessed at late night or early in the morning. Majority (80.9%) of the respondents reported that they had adequate computer skills to access and use the FPeL while 22 (19.1%) of them claimed that they do not have computer skill at all. However, in order to use FPeL, no specific skills were required.

C. **Materials**

Majority of FPeL users rated it to be either helpful (47%) or very helpful (28.7%). In relation to classroom lecture style, most (52.2%) of the users responded that the FPeL should be used as optional supplement, 35 (25.7%) responded that the online materials should be a mandatory supplement, while 18% responded that the online format is useful in place of some traditional lectures. Majority of FPeL users felt these virtual lectures are beneficial to their learning process of FP. FPeL assisted them in many ways especially as a preparation before traditional lecture and examination. During the lecture, note taking is not necessary since all the informations are available on FPeL and the students can confirm on information that they were not clear while reviewing FPeL earlier. Even though it is beneficial, only half of the users felt that FPeL should be used as optional supplement to the traditional lecture. In contrast, Pilcher in 2001 reported that majority of the students felt that online lecture should be a mandatory supplement. However, Padalino showed evidence of an equal acquisition of knowledge in both groups; confirming the efficacy of both methods. While in 2002, Spickard concluded that students who participated in an online lectures on screening saved time and achieved knowledge scores to those students who participated in traditional classroom lecture.

Freedom in learning specifically in term of time, pace and place were seen as the obvious benefit to the users. Sixty two users reported FPeL is very beneficial and 51 reported it is somewhat beneficial. These groups of users must have utilised the benefit of FPeL. However, using the same material in both lectures and e-learning may promote absenteeism among the students. Only 2 users described it was not beneficial to them.

D. **Students evaluation**

The FPeL were divided into 6 main topics according to prosthodontics syllabus. Each main topic was again divided into many subtopics. Users are able to choose the desired topic or module to review directly without having to go through earlier topics or modules. The content includes notes illustrated with clinical and laboratory photos (Table 1). On their evaluation regarding individual characteristics included in the FPeL, majority of users were agreeable or strongly agreeable to the syllabus, topics, contents, photos and illustrations as well as its helpfulness to the users. However, some users reported that the FPeL was moderately user friendly, not really easy to browse, difficult to access, slightly confusing and the subtopics were moderately helpful. Figures 1 and 2 showed pages displaying the main topics and subtopics.

### Table 1: Users rated on online lecture topics

<table>
<thead>
<tr>
<th>Topics</th>
<th>Not very helpful</th>
<th>Not helpful</th>
<th>Somewhat helpful</th>
<th>Very helpful</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to FP</td>
<td>2</td>
<td>2</td>
<td>20</td>
<td>73/63.4%</td>
</tr>
<tr>
<td>Examination &amp; Tx Planning</td>
<td>1</td>
<td>1</td>
<td>26</td>
<td>70/60.8%</td>
</tr>
<tr>
<td>Occlusion</td>
<td>2</td>
<td>6</td>
<td>28</td>
<td>57/49.5%</td>
</tr>
<tr>
<td>Facebow &amp; Articulators</td>
<td>1</td>
<td>3</td>
<td>33</td>
<td>60/52.1%</td>
</tr>
<tr>
<td>Esthetics</td>
<td>2</td>
<td>2</td>
<td>18</td>
<td>75/65.2%</td>
</tr>
<tr>
<td>Diagnostic Wax-Up</td>
<td>3</td>
<td>7</td>
<td>29</td>
<td>66/57.3%</td>
</tr>
<tr>
<td>Post &amp; Core</td>
<td>1</td>
<td>0</td>
<td>14</td>
<td>78/67.8%</td>
</tr>
<tr>
<td>Tooth Preparation</td>
<td>1</td>
<td>0</td>
<td>9</td>
<td>80/69.5%</td>
</tr>
<tr>
<td>Impression</td>
<td>1</td>
<td>3</td>
<td>15</td>
<td>73/63.4%</td>
</tr>
<tr>
<td>Provisional</td>
<td>1</td>
<td>1</td>
<td>23</td>
<td>68/59.1%</td>
</tr>
<tr>
<td>Dental Materials</td>
<td>2</td>
<td>2</td>
<td>23</td>
<td>69/60%</td>
</tr>
</tbody>
</table>
E. Comment and recommendation

Open-ended questions were utilized in the final part. The users were asked to comment on strength and weakness as well as their recommendation for future improvement of FPeL. Forty one respondents commented on the strengths FPeL. According to Figure 3, 17 users mentioned that FPeL is useful as it functioned as a guide before classroom lecture while 12 of them gave optimistic responses related to the quality of photos and illustrations as well as its attractive layout. Simple explanation counted as the third most common comments on strength. Unfortunately, only 4 respondents commented on its easy access where users can view FPeL anytime and anywhere.

As shown in Figure 4, problem with internet server was the most common. The performance of the server was the most common problem voiced by the students in term of their internet connection. Since the introduction of wireless connection in campus and hostel, the server became slower as a result of overloading and heavy on-line traffic for users. 10 respondents said they do not have easy internet access. Other weakness related to FPeL was that it was not printable or copyright exception, time consuming probably due to slow server or old version computer and too confusing due to too much materials or slides. In the future, only simple frameworks of lecture will be available in FPeL while the full version will be given during classroom lectures. Therefore, FPeL will become less confusing to the users.

Only 34 respondents gave recommendations toward future improvement of PFeL. PFeL users recommended and preferred a version with more explanations, illustrated with more photos and addition of references (Figures 5 and 6). The users suggested that the background colour should be changed and handout should be made available for them to print. Refer to Table 2 for user’s recommendations.
Table 2: Users recommendations

<table>
<thead>
<tr>
<th>Feedback - Recommendations</th>
<th>Users</th>
</tr>
</thead>
<tbody>
<tr>
<td>More explanation</td>
<td>9</td>
</tr>
<tr>
<td>More photos and illustrations</td>
<td>5</td>
</tr>
<tr>
<td>Printable version</td>
<td>10</td>
</tr>
<tr>
<td>To add references</td>
<td>4</td>
</tr>
<tr>
<td>To change FPeL’s background</td>
<td>3</td>
</tr>
<tr>
<td>To provide handouts</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
</tr>
</tbody>
</table>

CONCLUSIONS

PFeL assisted users in the learning process of fixed prosthodontics (FP). Valuable informations are useful to upgrade the FPeL. e-learning tool provide more a empowered teaching and learning environment for students. Lecturers will teach the course in two methods, a face-to-face mode and on-line mode using communication technologies via internet environment. During the class, students and lecturers will lead the discussion and question-answer dialogue to improve the quality of the teaching and learning process.

REFERENCES


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Evaluation Of Orthodontic Treatment Outcome: A Self-Audit Using The Peer Assessment Rating (PAR) Index

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ABSTRACT
Introduction: The peer assessment rating (PAR) index was used to self-audit 4 years of completed pre-adjusted edgewise appliance cases treated by a single orthodontist in a government clinic. The objectives of this study were to evaluate orthodontic treatment standards and factors which may influence treatment outcomes and treatment time. Methodology: Pre and post-treatment study models were scored using the PAR index by the author. 17 models were re-examined for intra-examiner reliability using intra-class correlation coefficient (ICC). ICC was excellent for pretreatment (0.96), post-treatment (0.98) and reduction in PAR (0.96) scores. Results: There were 173 cases (51 males; 122 females) with mean age 17.6 (SD 5.75) years. Mean treatment time was 18.6 (SD 6.47) months with range between 5-40 months. There was no statistically significant difference between one-arch and two-arch cases and between routine and compromised cases. Treatment time in extraction cases (mean 19.5, SD 6.17) was significantly different (p=0.000) compared with non-extraction cases (mean 11.6, SD 4.10) although this accounted for 15% of the variation only (r=0.388). 76.3% cases were ‘greatly improved’, 22.0% ‘improved’ and 1.7% ‘worst/no different’. Mean pretreatment, post-treatment and reduction in PAR score was 34.1(SD 9.68), 6.4 (SD 6.84) and 27.9 (SD 9.69) respectively. Mean percentage PAR score reduction was 82.0% (SD 1.96). Pretreatment (p=0.000), post-treatment (p=0.000) and reduction (p=0.489) in PAR scores was significantly different between routine and compromised cases. There was significant difference (p=0.000) between category of improvement and pretreatment scores but not with treatment time. Conclusion: Severe malocclusions had larger reduction in PAR scores and required longer treatment time. Extraction cases took longer to complete and routine cases had better outcomes than compromised cases with severe skeletal discrepancy.

Key Words: PAR index, pre-adjusted edgewise appliance, self-audit

INTRODUCTION
An orthodontic index is used to describe a rating or a categorizing system that assigns a numeric score or an alphanumerical label to a person’s occlusion. Several international indices like the Peer Assessment Rating (PAR) and Index of Treatment Complexity, Outcome and Need (ICON) which were developed in the United Kingdom and the American Board of Orthodontics Objective Grading System (OGS) have been developed and used to assess orthodontic treatment outcomes and standard. These indices compared pre and post-treatment study models to determine the quality of the results qualitatively or quantitatively. The PAR is a quantitative objective method designed to ensure uniform interpretation and application of criteria in measuring a malocclusion. It has been validated in many countries and in different ethnic groups. This index provides a single summary score for assessment of many of the occlusal anomalies present in the dentition. The overall weighted score indicates how much a malocclusion deviates from normal occlusion. The degree of improvement is expressed quantitatively as ‘percentage improvement’ or qualitatively as ‘greatly improved’, ‘improved’, ‘worst/no different’ by interpretation from the PAR nomogram. Besides its usefulness in rating performance and treatment outcomes, the PAR can also be used to indicate treatment severity, need and difficulty. Since the PAR is only assessed on study models and not on patients, one of the criticisms of the index is that the improvement in the dentition may not always be correlated with overall facial improvement. However, self-auditing is a useful exercise to evaluate personal performance, compare treatment techniques, elucidate factors influencing treatment options plus impart more accurate information to identify specific problems in individual patients.

The Clinical Effectiveness Committee of the British Orthodontic Society has developed a benchmark for the standard of treatment expected from consultant orthodontists in the United Kingdom following an audit on the treatment outcome of fixed appliance treatment by hospital-based orthodontists in 2003. Similarly, the PAR index has been adopted by the Ministry of Health Malaysia in recent years as a quality assurance and key performance indicator for orthodontic treatment carried out by government orthodontists. A general evaluation of the overall performance of government
orthodontists was reported at annual meetings. Unfortunately not all orthodontists submitted their PAR assessment results and no inferential analyses were done at the Ministry level.

Thus, the two main objectives of this study were to determine treatment outcomes and treatment time of cases completed by a single operator. Other patient variables which may influence treatment outcome and treatment time such as malocclusion severity, different treatment modalities and options were also evaluated.

MATERIALS AND METHODS

Sample selection
This is a cross-sectional of consecutively completed orthodontic cases over a 4-year period (mid-2003 to mid-2007), treated from start to finish with fixed appliances (± removable/functional appliances) by a single orthodontist in a government orthodontic clinic in Kedah, Malaysia. All fixed appliance cases were treated with pre-adjusted edgewise brackets and straight-wire technique. McGuiness and McDonald23 found highly significant (p<0.001) difference in treatment times when there were operator changes during treatment. The average treatment time for patients treated by one operator was 17.67 months (SD 4.15) compared with 26.1 months (SD 6.78) in one or more operators. Treatment with removable appliances per se has been reported to have poor treatment outcomes13,18. Thus for homogeneity, exclusion criteria included cases that had operator changes, transfer cases, removable or functional appliance therapy only, orthognathic surgery, cleft and craniofacial syndrome patients13,23,24.

PAR Index measurements
This index looks at 5 components of the occlusion, namely; the upper and lower anterior, segments, left and right buccal occlusion, overjet, overbite and centerline (Fig.1). The individual scores for each component are multiplied by the assigned weightings and then summed to establish the overall total score. Weightings derived for the 5 components are (x1) for upper and lower anterior segment alignment, (x1) for right and left buccal occlusion, (x6) for overjet, (x2) for overbite and (x4) for centerline. The total weighted PAR score is recorded for the pre- and post-treatment study models respectively. A total score of zero would indicate perfect alignment and higher scores indicate increased levels of irregularity or deviation from the ideal. The percentage change between pre- and post-treatment PAR scores indicates the degree of improvement.

Fig. 1: Scoring on pretreatment and post-treatment study models in 3 planes

Fig. 2: PAR ruler

Fig. 2: Measuring tooth displacement with PAR ruler
Measurements were made easier and quicker with the specifically designed PAR ruler. All models were scored with the PAR ruler by the author (Figs. 2 and 3). The PAR nomogram was used to categorize treatment outcome as ‘greatly improved’, ‘improved’ or ‘worst/ no different’ by reading the pre- and post-treatment scores from the respective axes (Fig.4). ‘Worse/no different’ scores reflect a reduction in weighted PAR score of less than 30%, ‘improved’ indicates an improvement equal to or greater than 30% and ‘greatly improved’ indicates an improvement of 22 or more PAR points.

The degree of improvement (% reduction in PAR score) was also expressed as a percentage. The degree of improvement as expressed by the nomogram is not directly correlated with percent improvement because the nomogram takes into account the size of the pretreatment score. The larger the pretreatment score means the more severe the malocclusion. This means that a 100% improvement in a mild malocclusion is only categorized as ‘improved’ by the nomogram. Conversely, a 70% improvement in a severe malocclusion may be categorized as ‘greatly improved’ due to the larger pretreatment score.

**Statistical Analysis**

All but one of the consecutively completed 174 cases was treated with fixed appliances. Thus, for homogeneity the only case treated with removable appliances was excluded from the study. Parametric tests were used to analyse treatment time, pretreatment scores and reduction in PAR scores since there was normal distribution and homogeneity of variances in the sample. One-way analysis of variance (ANOVA) was used to test differences in treatment time between extraction versus non-extraction patients, one-arch versus two-arch treatment, routine versus compromised treatment and one-arch versus two-arch extractions. Bonferroni’s Post Hoc Multiple Comparisons were run to compare means in more than three groups. Where test assumptions were not met, the Wilcoxon signed ranks test was used to test for significance. Pearson’s correlation coefficient or Spearman’s rank correlation were applied where assumptions were met to test for association between the variables. Patients were regrouped into different treatment modalities for statistical analyses.

**RESULTS**

There was excellent intra-examiner reliability with ICC of 0.96, 0.98, 0.96 and 0.97 for pretreatment, post-treatment scores, reduction in scores and percent improvement respectively. Agreement was excellent in ‘categorization of improvement’ with mean kappa statistic of 0.68. There were a total of 173 cases comprising 51 males (29.5%) and 122 (70.5%) females, with ethnic distribution of 73 (42.2%) Malays, 93 (53.8%) Chinese, 6 (3.5%) Indians and 1 (0.6%) others with mean age 17.6 (SD 5.75) years. 128 (74.0%) cases were treated with two-arch fixed appliances compared with 33 (19.1%) one-arch fixed, 10 (5.8%) cases with full-fixed + active removable plates and 2 (1.2%) cases with full-fixed + functional appliances. Treatment time was normally distributed with a mean of 18.6 (SD 6.47) months and range 5-40 months.
Evaluation Of Orthodontic Treatment Outcome: A Self-Audit Using The Peer Assessment Rating (PAR) Index

i. Treatment time with different variables (Tables 1 and 2)

Extraction v non-extraction

There were 20 non-extraction and 153 (48 one-arch, 105 two-arch) extraction cases. The most common extraction pattern was a combination of two upper and two lower premolars (40.8%) followed by two upper premolars only (19.5%) and non-routine extraction combination (12.6%). Extraction cases took longer to complete with mean treatment time of 19.5 (SD 6.17) months compared with 11.6 (SD 4.10) months in non-extraction cases. Mean treatment time for one-arch and two-arch extraction cases was 18.3 (SD 6.03) and 20.1 (SD 6.16) months respectively (Table 1). There was statistically significant difference between non-extraction (p=0.000) and extraction cases, but no significant difference between one-arch and two-arch extraction cases. Although there was positive association between treatment time and extraction/non-extraction modality, this factor only accounted for about 15.1% of the variation (r=0.388).

When the extraction cases were regrouped into routine extractions (n=130) and non-routine extractions (n=22), mean treatment time was 19.6 (SD 6.17) and 18.9 (SD 6.27) months respectively. ANOVA and Post hoc tests showed there was statistically significant difference in treatment times between non-extraction and these two groups of extraction cases (p=0.000) but not within the extraction cases.

Fixed one-arch v two-arch

Mean treatment time for one-arch and two-arch cases was 17.5 (SD 6.75) and 18.9 (SD 6.36) months respectively. Two-arch treatment which required additional active removable plates or functional appliances had a mean treatment time of 17.9 (SD 6.64) months. There was no statistically significant difference in treatment times between these three groups.

Routine v compromised cases

There was no statistically significant difference in mean treatment time for routine (18.7 months, SD 6.51) and compromised cases (18.4 months, SD 6.29).

Pretreatment, post-treatment and reduction in PAR scores (Table 2)

There was positive correlation and statistical significance between treatment time and pretreatment PAR score (p=0.001) and with reduction in PAR score (p=0.001).

Table 1: Descriptive statistics and ANOVA tests for treatment time with different variables

<table>
<thead>
<tr>
<th>Variable groups</th>
<th>N(%)</th>
<th>Treatment time</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>S.D.</td>
</tr>
<tr>
<td>1. Non-Extraction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extraction 1 arch</td>
<td>20(11.6)</td>
<td>11.6</td>
<td>4.10</td>
</tr>
<tr>
<td>Extraction 2 arch</td>
<td>48(27.7)</td>
<td>18.3</td>
<td>5.98</td>
</tr>
<tr>
<td>2. Fixed 1 arch</td>
<td>105(60.7)</td>
<td>20.1</td>
<td>6.16</td>
</tr>
<tr>
<td>Fixed 2 arch</td>
<td>37(21.4)</td>
<td>17.5</td>
<td>6.75</td>
</tr>
<tr>
<td>2. Routine cases</td>
<td>136(79.6)</td>
<td>18.9</td>
<td>6.36</td>
</tr>
<tr>
<td>Compromised cases</td>
<td>30(17.3)</td>
<td>18.4</td>
<td>6.29</td>
</tr>
</tbody>
</table>

Table 2: Descriptive statistics and significance test for treatment time and PAR scores in the total sample

<table>
<thead>
<tr>
<th>N</th>
<th>Treatment time</th>
<th>PAR scores</th>
<th>Post-treatment</th>
<th>Reduction</th>
<th>% improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
</tr>
<tr>
<td>173</td>
<td>18.6</td>
<td>6.47</td>
<td>34.1</td>
<td>9.68</td>
<td>6.4</td>
</tr>
</tbody>
</table>

P=.001, P=, P=.001, ns

Significance set at p<.05
Ns= not significant
**Category of improvement**

There was statistically significant difference (p=0.029) in mean treatment time between the categories of improvement with longer treatment time in ‘greatly improved’ cases compared with ‘improved’ and ‘worse/no different’ cases (Table 3).

**ii. Treatment outcomes with different variables (Tables 2-5)**

Since there was no statistically significant difference in pre- and post-treatment, reduction in PAR and percent reduction in PAR scores between males and females, the sample was analysed as a whole.

**Percentage improvement**

Mean pretreatment, post-treatment and reduction in PAR scores in the sample was 34.1 (SD 9.68), 6.4 (SD 6.84) and 27.9 (SD 9.69) respectively (Table 2). The mean PAR score reduction was 82.0% (SD 1.96). Pretreatment scores were positively correlated with post-treatment scores (p=0.01).

**PAR scores and different variables (Table 3)**

There was no statistically significant difference in mean pretreatment and post-treatment scores in extraction and non-extraction cases. However, there was statistical significant difference in the reduction of PAR scores between extraction and non-extraction cases. There was statistical significant difference in pretreatment (p=0.019) and reduction in PAR scores (p=0.000) between one-arch and two-arch treatment. Mean pretreatment scores for routine cases was lower (32.7) compared with compromised cases (40.8) and it was statistically significant (p=0.000). Mean post-treatment scores in routine and compromised cases was 5.2 (SD 5.68) and 11.8 (SD 9.06) respectively. The Wilcoxon Signed ranks test was used to test for statistical significance in the post-treatment and reduction in PAR scores in these two groups as assumptions were not met for ANOVA test. There was statistically significant difference (p=0.000) in both post-treatment and reduction in PAR scores.

**Table 3: Descriptive statistics and significance tests for PAR scores for variable groups**

<table>
<thead>
<tr>
<th>Variable groups</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>P</th>
<th>Mean</th>
<th>SD</th>
<th>P</th>
<th>Mean</th>
<th>SD</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Non-Extraction</td>
<td>20</td>
<td>.030*</td>
<td>7.17</td>
<td>.062</td>
<td>7.3</td>
<td>7.01</td>
<td>.872</td>
<td>23.1</td>
<td>7.42</td>
<td>.030*</td>
</tr>
<tr>
<td>Extraction 1 arch</td>
<td>48</td>
<td>33.0</td>
<td>9.71</td>
<td>6.6</td>
<td>7.68</td>
<td>27.1</td>
<td>11.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extraction 2 arch</td>
<td>105</td>
<td>35.3</td>
<td>9.95</td>
<td>6.1</td>
<td>6.45</td>
<td>29.1</td>
<td>8.84</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Fixed 1 arch</td>
<td>37</td>
<td>30.8</td>
<td>8.95</td>
<td>.021*</td>
<td>8.3</td>
<td>8.96</td>
<td>.167</td>
<td>22.5</td>
<td>9.59</td>
<td>.000*</td>
</tr>
<tr>
<td>Fixed 2 arch</td>
<td>136</td>
<td>35.0</td>
<td>9.73</td>
<td>5.9</td>
<td>6.08</td>
<td>29.3</td>
<td>9.22</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Routine cases</td>
<td>143</td>
<td>32.7</td>
<td>9.1</td>
<td>.000*</td>
<td>5.2</td>
<td>5.7</td>
<td>.000*</td>
<td>27.7</td>
<td>8.9</td>
<td>.383</td>
</tr>
<tr>
<td>Compromised case</td>
<td>30</td>
<td>40.8</td>
<td>9.9</td>
<td>11.8</td>
<td>9.1</td>
<td>29.0</td>
<td>12.9</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Mann-Whitney U test for ‘fixed 1 arch/two arch’ and ‘routine/compromised’ cases.  
Kruskal-Wallis rank sum test for ‘non-extraction/extraction’ groups*
Evaluation Of Orthodontic Treatment Outcome: A Self-Audit Using The Peer Assessment Rating (PAR) Index

There were 132 (76.3%) ‘greatly improved’, 38 (22.0%) ‘improved’ and 3 (1.7%) ‘worse/ no different’ cases. There was statistical significant difference between mean pretreatment (p=.000), post-treatment (p=.000) and reduction in PAR scores (p=.000) and treatment time (p=.029) with the different categories of improvement (Table 4). More cases were ‘greatly improved’ in two-arch extraction cases; two-arch treatment and routine cases (Table 5).

Table 4: Descriptive statistics and ANOVA tests for Mean PAR scores and treatment time for category of improvement

<table>
<thead>
<tr>
<th>Variable</th>
<th>Worse/ no different</th>
<th>Improved</th>
<th>Greatly improved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pretreatment PAR score</td>
<td>38.3 (17.2)</td>
<td>23.6 (6.7)</td>
<td>37.0 (8.0)</td>
</tr>
<tr>
<td>Post-treatment PAR score</td>
<td>26.0 (12.0)</td>
<td>7.2 (7.0)</td>
<td>5.7 (5.9)</td>
</tr>
<tr>
<td>Reduction in PAR score</td>
<td>12.3 (23.6)</td>
<td>16.4 (4.7)</td>
<td>31.5 (7.1)</td>
</tr>
<tr>
<td>Percent reduction in PAR score</td>
<td>16.9% (54.6%)</td>
<td>72.6% (23.1%)</td>
<td>86.2% (19.6%)</td>
</tr>
<tr>
<td>Treatment time</td>
<td>15.0 (6.9)</td>
<td>16.4 (6.4)</td>
<td>19.3 (6.3)</td>
</tr>
</tbody>
</table>

Table 5: Descriptive statistics of category of improvement for different variables

<table>
<thead>
<tr>
<th>Variable groups</th>
<th>Worse/ no different</th>
<th>Improved</th>
<th>Greatly improved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Non-Extraction</td>
<td>20(11.6)</td>
<td>7 (35.0)</td>
<td>13 (65.0)</td>
</tr>
<tr>
<td>Extraction 1 arch</td>
<td>48(27.7)</td>
<td>12 (25.0)</td>
<td>35 (72.9)</td>
</tr>
<tr>
<td>Extraction 2 arch</td>
<td>105(60.7)</td>
<td>19 (18.1)</td>
<td>84 (80.0)</td>
</tr>
<tr>
<td>2. Fixed 1 arch</td>
<td>37(21.4)</td>
<td>12 (32.4)</td>
<td>23 (62.2)</td>
</tr>
<tr>
<td>Fixed 2 arch</td>
<td>136(79.6)</td>
<td>26 (19.1)</td>
<td>109 (80.1)</td>
</tr>
<tr>
<td>3. Routine cases</td>
<td>143(82.7)</td>
<td>33 (23.1)</td>
<td>110 (76.9)</td>
</tr>
<tr>
<td>Compromised cases</td>
<td>30(17.3)</td>
<td>5 (16.7)</td>
<td>22 (73.3)</td>
</tr>
</tbody>
</table>

iii. Factors associated with PAR score change (Table 6)

Multiple linear regression analysis of PAR score change with pretreatment and post-treatment PAR scores showed high association with these two variables (r=0.969). This was predicted and excluded when running analysis with other possible factors. Other possible predictors included were one/two-arch treatment, extraction/non-extraction, routine/compromised cases and treatment time. Multiple linear regression analysis showed that variability in arch treatment (p=.029), routine/compromised cases (p=.000) and treatment time (p=.000) were associated with PAR score change although this contributed to about 17% of possible factors (r=0.435).
Table 6: Multiple linear regression of ‘Reduction in PAR score’ with extraction/non-extraction, one-arch/two-arch treatment, routine/compromised treatment and treatment time

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>sig</th>
<th>R</th>
<th>Adjusted R square</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>4.732</td>
<td>3.853</td>
<td>1.228</td>
<td>.221</td>
<td>.438a</td>
<td>.172</td>
</tr>
<tr>
<td>Extraction/ non-extraction</td>
<td>-.715</td>
<td>1.151</td>
<td>-.051</td>
<td>.622</td>
<td>.535</td>
<td></td>
</tr>
<tr>
<td>Routine/ compromised</td>
<td>.826</td>
<td>.375</td>
<td>.162</td>
<td>2.201</td>
<td>.029*</td>
<td></td>
</tr>
<tr>
<td>Treatment time</td>
<td>.457</td>
<td>.113</td>
<td>.304</td>
<td>4.032</td>
<td>.000*</td>
<td></td>
</tr>
<tr>
<td>One-arch/ two-arch</td>
<td>7.921</td>
<td>1.901</td>
<td>.336</td>
<td>4.166</td>
<td>.000*</td>
<td></td>
</tr>
</tbody>
</table>

a. Predictors: (Constant), extraction, case type, treatment time, arch treatment
b. Dependent variable: Reduction in PAR score

DISCUSSION

Mean treatment duration for fixed appliances in the present study was 18.6 (SD6.47) months. This was comparable with other studies reporting mean treatment time from 15-25 months. The current study showed that a higher pretreatment PAR score and a greater percent reduction in PAR score were significantly associated with longer treatment durations as similarly observed in other studies. Holman et al. reported longer treatment duration for extraction (29.7±6.1 months) than non-extraction cases (26.0±7.2 months) similar to the current study which showed statistical significant difference in extraction cases (11.6±4.10 months) compared to non-extraction cases (19.5±6.17 months). They observed that pretreatment PAR scores was a significant factor (p≤0.0001) in extraction decisions in contrast to the present study.

The mean percentage reduction in PAR score was more than 80% in the present study which was comparable to the above 75% reduction reported in studies carried out in other countries. Onyeaso and Begole reported statistically significant differences between the three improvement groups for pretreatment PAR scores similar to the present study. Riedmann and Berg reported lower mean percentage reduction in PAR score in compromised cases (37%) than ideal cases (73%). The current study similarly observed statistically significant difference (p=0.000) in percent improvement in routine (84.7%) compared with compromised (69.2%) cases, although the association is low. The average length of treatment in their ideal cases was 28.8 months which was longer compared with 18.7 months in the current study. There was no significant differences in treatment time between these two groups in the current study but was halved in compromised cases in their study.

Two-arch treatment produced more ‘greatly improved’ results than one-arch. Fox reported that only the appliance type was significantly related to PAR score change in contrast to other studies that reported high percentage variability of PAR change due to initial PAR score. The present study similarly found statistically significant association (p=0.01) between pretreatment and post-treatment PAR score, and between pretreatment and reduction in PAR score. This is obvious since PAR score change is the difference in pre- and post-treatment PAR score. Multiple linear regression analysis showed that variables such as one-arch/two-arch treatment, routine/compromised cases and treatment time was associated with PAR score change although they contributed to about 17% of factors (r=.438).

Richmond proposed that the mean percentage reduction in PAR score should be greater than 70% to be considered a good standard of orthodontic treatment and that the proportion of patients in the ‘worse/no different’ category should ideally be less than 5%. This was comparable to the present study where the mean percentage reduction in PAR score was 82% and only 1.7% cases fell in the ‘worse/no different’ group. Teh et al. reported a low mean reduction in PAR score of 14.9 (SD10.6) and mean percentage reduction in PAR of 59% by orthodontic specialists in the General Dental Service in Scotland. They attributed the modest improvement in treatment to the low mean pretreatment PAR score and the borderline need for treatment in many cases.

Although there are specific indices for assessing treatment need like the Index of Orthodontic Treatment Need (IOTN), pretreatment PAR scores have been shown to be useful as an indicator for orthodontic treatment need. Firestone et al. found that both the US PAR and UK PAR weighted scores were excellent predictors of orthodontic treatment need and suggested that the cutoff point for treatment need as 17. McGorray et al. and Soh et al. similarly showed that the PAR index was highly correlated with orthodontists’ subjective/aesthetic assessment of treatment need and suggested the optimum cutoff.
PAR scores as 17-20. Low IOTN scores may have higher pretreatment PAR scores especially with mal-alignment confined to the upper labial segment. This is probably due to heavier weightings for overjet, centerline and overbite. In the present study, low pretreatment PAR scores ≤17 accounted for less than 3.5% (6 cases) of the cases treated. This observation combined with the high mean percentage reduction in PAR score and the large proportion of ‘greatly improved’ cases indicates that the practitioner is treating a great proportion of cases with a clear need for treatment to a high standard. This reflects the acceptance of cases for treatment in accordance with referral guidelines set by the Ministry of Health Malaysia.

Fox observed that 36.3% of their ‘worst/no different’ cases were due to compromised treatment. Some outliers with unusually long treatment time in the present sample were attributed to patient’s failure to attend regular treatment and frequent appliance breakages. Robb et al. similarly found that the number of broken appointments and appliance repairs accounted for about 46% in additional treatment time. Difficult cases were characterized by greater pretreatment malocclusion severity and need for treatment, greater residual malocclusion post-treatment, problems with hygiene and compliance, extractions and changes in treatment plan, more appointments and longer treatment duration. Hamdan and Rock suggested new weightings for different malocclusion classes due to the high weightings to overjet in the PAR index. They proposed the utilization of a combination of point and percentage reduction in PAR scoring which appear to have better correlation than the nomogram. Although the US weightings were modified from the UK weightings to exclude the lower labial segment, studies have shown little difference when it was applied to assess treatment need. But the modified US weightings may not be appropriate if it was used to appraise treatment modalities or outcomes which may have relapse of the treatment in accordance with referral guidelines set by the same clinician treating the cases. Ideally, the scoring is done by another person other than the attending orthodontist to reduce possible bias.

CONCLUSION

Treatment standard was high with more than 98% of cases ‘improved’ or ‘greatly improved’ in cases with a clear need for treatment. There was mean PAR score reduction of 82% and mean posttreatment PAR score of 6.4. Severe malocclusions had larger mean pretreatment scores and took longer treatment time. There was statistically significant difference in pretreatment, post-treatment and reduction in PAR scores between routine and compromised cases but not in treatment time. Mean treatment time was 18.6 months (SD 6.47) with extraction cases taking longer than non-extraction cases. Reduction in PAR score was highly associated with pretreatment and post-treatment PAR scores. Self-audit using the PAR index is a simple, pragmatic and invaluable exercise to assess treatment outcomes and treatment time in different treatment modalities.

ACKNOWLEDGEMENT

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Knowledge Of Prescribing Antimicrobial Among Dental Practitioners In Klang Valley Region

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ABSTRACT

There is a major concern about the increased use of antibiotics in dental practice and the emergence of resistant bacterial strains. In recent years, dentists have reported a shift from narrow-spectrum to broad-spectrum antibiotic prescriptions due to increasing antibiotic resistance. The aims of this study are to investigate the prescribing patterns of the therapeutic and prophylactic use for antibiotics in various dental situations by dental practitioners. The study also specifically investigates the prescribing habits of dental practitioners regarding certain cardiac conditions and related dental procedures in patients predisposed to infective endocarditis. This study utilized a questionnaire which was designed to investigate the antibiotic prescribing patterns by dental practitioners in the Klang Valley region. The returned questionnaires were analyzed using SPSS, to identify compliance to antibiotic guidelines by Malaysia National Clinical Guidelines (MNCG) (2003) and American Heart Association Guidelines (AHAG) (2008). 217 dentists responded to the questionnaire and the responses show that there is a wide variety of antibiotic prescriptions among dentists and there is also misuse of antibiotics in some clinical dental conditions. The results also show that there is a large variation in the antibiotic prescriptions patterns for prophylaxis against infective endocarditis. Furthermore, there is uncertainty as to which cardiac conditions required prophylaxis and for which particular dental procedures. This study concludes that there is a clear need for the development of prescribing guidelines, regular monitoring of antibiotic prescriptions by dental practitioners and educational initiatives to encourage the rational and appropriate use of the antibiotics.

Key Words: Antibiotics, dental practitioners, therapeutics, prophylactic.

INTRODUCTION

Antibiotics along with analgesics are the most common drugs used in dentistry; their judicious use can shorten the course of infection and minimize associated risks such as the spread of infection to adjacent anatomical spaces or systemic involvement. There is a widespread concern about the exaggerated use of antibiotics in dental practice and the emergence of resistant bacterial strains. In recent years, dentists have reported a shift from narrow-spectrum to broad-spectrum antibiotic prescriptions due to increasing antibiotic resistance. There are evidences which suggest that antibiotic prescriptions by dental practitioners for therapeutic purpose differ significantly and prophylactic antibiotics are prescribed inappropriately, both for surgical procedures and for patients at risk from endocarditis.

The objectives of this study are to:
1) investigate the antibiotic dose, frequency and duration of treatment (days) that the practitioners would prescribe for patients with an acute dental infection, with and without allergy to penicillin;
2) investigate the use of antibiotics for clinical dental conditions;
3) determine dentists’ prescription habits of antibiotic prophylaxis for some cardiac conditions and
4) determine their prescription habits of antibiotic prophylaxis for some dental procedures in patients at risk of infective endocarditis (I.E.).
METHODOLOGY

This study utilized a questionnaire which was designed to investigate the antibiotic prescribing patterns by dental practitioners in the Klang valley region. To prepare the questionnaire, references were made to studies such as, Palmer et al, Jaunay et al and Thompson et al and the questionnaire was modified after a pilot study.

There are around 1300 dentists registered in the Klang valley region. For this population, the sample size is 20%, assuming a response rate of 70% or more. Due to the low response rate, typical for questionnaire study, over sampling should be considered to bring the number of answers to the desired value. 706 questionnaires were distributed to the dental practitioners. The distribution method and the response rate are demonstrated in Table 1.

The returned questionnaires were analyzed using SPSS to identify the compliance to antibiotic guidelines: MNCG 2003 and AHAG 2008. The Defined Daily Dose (DDD) was also calculated.

Table 1: Response rate

<table>
<thead>
<tr>
<th>Location</th>
<th>Copies given</th>
<th>Retured answers</th>
<th>Response rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot study</td>
<td>50</td>
<td>25</td>
<td>50</td>
</tr>
<tr>
<td>University Malaya</td>
<td>100</td>
<td>18</td>
<td>18</td>
</tr>
<tr>
<td>University Teknologi MARA</td>
<td>38</td>
<td>19</td>
<td>50</td>
</tr>
<tr>
<td>University Kebangsaan Malaysia</td>
<td>30</td>
<td>2</td>
<td>6.6</td>
</tr>
<tr>
<td>Malaysian Dental Association conference</td>
<td>225</td>
<td>69</td>
<td>30.6</td>
</tr>
<tr>
<td>UiTM conference</td>
<td>43</td>
<td>21</td>
<td>48.83</td>
</tr>
<tr>
<td>By post</td>
<td>160</td>
<td>37</td>
<td>23.12</td>
</tr>
<tr>
<td>Self administration</td>
<td>60</td>
<td>26</td>
<td>43.33</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>706</strong></td>
<td><strong>217</strong></td>
<td><strong>30.7</strong></td>
</tr>
</tbody>
</table>

RESULTS

The actual data collection was carried out from January to July 2009. This survey was answered by 217 dentists. The demographics of the practitioners are represented in Table 2.

Table 2: The demographics of the respondents

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>28%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>72%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Principle work</th>
<th>Clinical dentists</th>
<th>81%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lecturers</td>
<td>10%</td>
</tr>
<tr>
<td></td>
<td>Researchers</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>6%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Years of experience</th>
<th>&lt; 5 years</th>
<th>26%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5-10 years</td>
<td>32%</td>
</tr>
<tr>
<td></td>
<td>10 &lt; years</td>
<td>42%</td>
</tr>
</tbody>
</table>

Choice of Antibiotics for Treatment of Acute Dentoalveolar Infection

Table 3 shows the daily frequency of dosage and the length of the course for antibiotic choice for patients not allergic to penicillin. Amoxicillin is the antibiotic of choice in 25.8% of practitioners. The normal dosage of amoxicillin used is 500 mg 3 times daily for 5 days (7.5 DDDs for each prescription).
Table 3: Antibiotic prescription by dentists for acute dentoalveolar infection showing frequency of dosage and number of days for patients not allergic to penicillin

<table>
<thead>
<tr>
<th>Drug type</th>
<th>Antibiotic</th>
<th>Daily Frequency</th>
<th>Numbers of days</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dosage (mg)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>250</td>
<td>1</td>
<td>1</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>1</td>
<td>8</td>
<td>93</td>
</tr>
<tr>
<td></td>
<td>3000</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>615</td>
<td>0</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>Clavulinate</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Penicillin</td>
<td>250</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>0</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Cephalaxin</td>
<td>125</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1000</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>250</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>200</td>
<td>1</td>
<td>1</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>1</td>
<td>15</td>
<td>45</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>250</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td>0</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>5</td>
<td>39</td>
<td>213</td>
</tr>
</tbody>
</table>

Figure 1 shows the antibiotics prescribed by practitioners for adults with an acute dentoalveolar infection for patients not allergic to penicillin.

Figure 1: Antibiotics prescribed by dentists (n=217) for treatment of acute dentoalveolar infection for patients not allergic to penicillin.

The choices of therapeutic antibiotic for patients allergic to penicillin are shown in Figure 2. Table 4 shows the daily frequency and number of days for antibiotics choice for patients allergic to penicillin. Erythromycin (250 mg) is used by 21.2% of practitioners, 3 times daily for 5 days (5 DDDs).

Figure 2: Antibiotics prescribed by dentists (n=217) for treatment of acute dentoalveolar infection for patients allergic to penicillin.

Prescribing Antibiotics for Specific Clinical Conditions

The percentages of dentists prescribing antibiotics for specific dental conditions are shown in Figure 3, with the majority prescribing antibiotics for acute periodontal abscess, pericoronitis, dry socket and acute periapical infection (API) before and after drainage.
Table 4: Antibiotic prescription by dentists for acute dentoalveolar infection showing frequency of dosage and number of days for patients allergic to penicillin

<table>
<thead>
<tr>
<th>Drug type</th>
<th>Antibiotic</th>
<th>Daily Frequency</th>
<th>Numbers of days</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dosage (mg)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Amoxicillin</td>
<td>250</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Amoxicillin Clavulinate</td>
<td>625</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Cephalaxin</td>
<td>125</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>500</td>
<td>0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>250</td>
<td>0</td>
<td>2</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>0</td>
<td>8</td>
<td>14</td>
</tr>
<tr>
<td>EES</td>
<td>400</td>
<td>0</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>Clarithromycin</td>
<td>250</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Clindamycin</td>
<td>150</td>
<td>0</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>450</td>
<td>0</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>Metronidazole</td>
<td>200</td>
<td>1</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>0</td>
<td>11</td>
<td>48</td>
</tr>
<tr>
<td>Tetracycline</td>
<td>250</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td>0</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>2</td>
<td>49</td>
<td>142</td>
</tr>
</tbody>
</table>

The dentists’ choices of antibiotics for the surveyed dental conditions for medically fit patients and not allergic to penicillin are shown in Figure 4. The three most used antibiotics are amoxicillin, metronidazole and a combination of the two antibiotics. For cellulitis in particular, the results show that there is a wide variation of antibiotic prescriptions for this condition (Figure 5).
Antibiotic Prophylaxis for Patients at Risk of Infective Endocarditis

The prophylactic antibiotic regimes used by dentists for patients not allergic to penicillin are shown in Figure 6. The antibiotic regimes used by dentists for patients allergic to penicillin are shown in Figure 7. Table 5 shows that the majority of dentists prescribed antibiotics for patients with previous I.E., prosthetic heart valve, unrepaird cyanotic heart disease and mitral valve incompetence. Table 6 represents dentists’ responses regarding which dental procedure required antibiotic prophylaxis in patients at risk from I.E.

Table 5: Dentists’ responses to which cardiac conditions require antibiotic prophylaxis in adult patients for invasive dental procedure

<table>
<thead>
<tr>
<th>Patients’ conditions</th>
<th>Yes response (%)</th>
<th>Didn’t know (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unrepaired cyanotic congenital heart disease</td>
<td>70.0</td>
<td>8.3</td>
</tr>
<tr>
<td>Previous I.E.</td>
<td>94.9</td>
<td>0.9</td>
</tr>
<tr>
<td>Prosthetic heart valve</td>
<td>86.6</td>
<td>1.8</td>
</tr>
<tr>
<td>Mitral valve incompetence</td>
<td>70.0</td>
<td>5.1</td>
</tr>
<tr>
<td>Innocent heart murmur</td>
<td>13.0</td>
<td>4.2</td>
</tr>
<tr>
<td>Recent MI</td>
<td>27.2</td>
<td>6.9</td>
</tr>
<tr>
<td>Rheumatic fever</td>
<td>51.2</td>
<td>3.2</td>
</tr>
<tr>
<td>Old MI</td>
<td>12.0</td>
<td>3.2</td>
</tr>
<tr>
<td>Pacemaker or an implantable cardiac defibrillator</td>
<td>41.7</td>
<td>7.4</td>
</tr>
</tbody>
</table>

Table 6: Dentists’ responses to the type of dental procedure requiring antibiotic prophylaxis for patients at risk of I.E.

<table>
<thead>
<tr>
<th>Procedures</th>
<th>Yes response (%)</th>
<th>Do not do it (%)</th>
<th>Do Not know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Placement of rubber dam</td>
<td>20.3</td>
<td>16.1</td>
<td>0</td>
</tr>
<tr>
<td>Tooth extraction</td>
<td>98.2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Placement of orthodontic band</td>
<td>27.2</td>
<td>9.7</td>
<td>0.5</td>
</tr>
<tr>
<td>Placement of orthodontic bracket</td>
<td>9.2</td>
<td>10.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Endodontic debridement where instruments are not passed through the root apex</td>
<td>29.6</td>
<td>4.1</td>
<td>0.5</td>
</tr>
<tr>
<td>Endodontic obturation (post placement and build up)</td>
<td>14.3</td>
<td>3.7</td>
<td>0.9</td>
</tr>
<tr>
<td>Taking of oral radiograph</td>
<td>8.3</td>
<td>0</td>
<td>0.5</td>
</tr>
<tr>
<td>Bleeding from trauma to the lips or oral mucosa</td>
<td>69.9</td>
<td>0.9</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Figure 6: Antibiotic prophylaxis regimes used by dentists (n=217) for patients predisposed to I.E., not allergic to penicillin
DISCUSSION

Choice of Antibiotics for Treatment of Acute Dentoalveolar Infection

This study found that amoxicillin is the most frequently prescribed antibiotics for acute dentoalveolar infection for patients not allergic to penicillin. Although there are some studies recommended amoxicillin or amoxicillin calvulanate for treatment of dental infection 12, 13 but the MNCG 2003 14 still recommend phenoxymethyl penicillin 250-500 mg as the first choice for the treatment of acute dentoalveolar infection, and this may be due to its efficacy in polymicrobial infections, relatively narrow spectrum for bacteria than amoxicillin and amoxicillin/calvulanate low toxicity and low cost 12.

Compared with other studies, amoxicillin has also been prescribed by the dental practitioners in England and Australia and there was a tendency towards a lower dosage over a long period of time 1, 3. However in Norway, Al-Haroni and Skaug reported that dentists preferred to prescribe penicillin and narrow spectrum antibiotics, leading to a low prevalence of antibiotic resistance among oral bacteria 15.

Some practitioners used amoxicillin in combination with metronidazole. The combination antibiotic therapy should be avoided, as the use of combination therapy resulted to a broad –spectrum exposure that led to depression of the normal host flora and increased opportunity for resistant bacteria to merge. For routine infections the disadvantages of combination therapy outweigh the advantages 16.

Recent guidelines published by the Commission of the Federation Dentaire International recommend that combination therapy should be avoided whenever possible in dentistry 17.

The dentists’ antibiotic choices for treatment of acute dentoalveolar infection for patients’ allergic to penicillin comply with the MNCG 2003 guidelines 14. Erythromycin is also widely used in the medical field in Malaysia 18 in spite of its resistance which can even develop during a course 3, 13. Kakoei et al suggested that the wide use of erythromycin in different parts of the world may be related to its recommendation in previous literatures and its low price 19.

Although DDDs of the prescribed antibiotic complies with the MNCG 2003, there is still a wide variation in the antibiotic prescribing patterns among surveyed dental practitioners.

The reason for this diverse antibiotic prescriptions is unclear. Previous studies suggested that the prescription is influenced by undergraduate and postgraduate education and the pharmaceutical industry 1.

Other factors which may influence the dental practitioners’ prescriptions include: patient’s expectation, the inability to make a definitive diagnosis or the treatment had to be delayed. However, the decision to prescribe antibiotics must be based on a thorough medical history, clinical examination and accurate diagnosis 1, 20, 21.

Prescribing Antibiotics for Specific Dental Conditions

The treatment of acute pulpitis includes extraction, endodontic treatment or pulp capping. According to Cochrane systematic reviews, there was no evidence which support the use of antibiotics for pain relief in pulpitis 22-24 and the Malaysian guidelines also did not mention antibiotics for acute pulpitis. In this study, about 40% of dental practitioners surveyed prescribed antibiotics for this condition.

About 80% used antibiotics for acute periapical infection (API) before drainage and 60.5% prescribed antibiotics after drainage was established. Systematic literature on the effectiveness of antibiotics intervention in the management of API indicated that the use of antibiotics has no additional benefit, unless there are systemic complications (e.g. fever, lymphadenopathy or cellulitis). Drainage of an infection is necessary in the majority of uncomplicated swellings 25-28.

The majority of dental practitioners surveyed in the study routinely prescribed antibiotics for dry socket, pericoronitis and periodontal abscesses although these three conditions can be effectively treated by local measures and antibiotics are only indicated for large spreading infections or systemic involvement 29-35.

In case of chronic periodontitis the use of topical antibiotics as an adjunct to scaling and root planning is sufficient to resolve this condition 36. In this study however, 20% prescribed antibiotics for chronic periodontitis.

The use of antibiotics in implant dentistry is controversial; the scientific evidence is not sufficient to either recommend or discourage the use of preoperative systemic antibiotics to prevent dental implant complications or failure 37-41, and prophylaxis antibiotics are recommended in subjects with risk factors including immune suppressed patients with metabolic disorders 42; however, in this current study, only 20% of practitioners prescribed antibiotics for this condition.
The majority of dental practitioners surveyed prescribed antibiotics for cellulitis, and there is a wide variety of antibiotics used for this condition as shown in Figure 5. However, penicillin (250-500 mg) 4 times a day has been recommended to treat this condition by surveyed dental practitioners who prescribed antibiotics for cellulitis, and this might be due to the fact that there are only general guidelines on prescribing rather than a definitive regimen. The dental practitioners need clear and practical guidelines on when to prescribe, what to prescribe, the duration and in what dose.

These results support the conclusion that there is overprescribing of antibiotics in dental practice and this might be due to the fact that there are only general guidelines on prescribing rather than a definitive regimen. The dental practitioners need clear and practical guidelines on when to prescribe, what to prescribe, the duration and in what dose.

**Antibiotic Prophylaxis for Patients at Risk of Infective Endocarditis**

This study found that 66.4% of dental practitioners follow the AHA guidelines (2008) in their prophylaxis prescription for patients not allergic to penicillin who were at risk of I.E. For patients allergic to penicillin, a majority of dentists surveyed follow AHA guidelines. On the other hand, there were 3% of surveyed dentists who used amoxicillin for patients allergic to penicillin, and this is contraindicated because of anaphylaxis and hypersensitivity reactions.

In general, compliance with antibiotic prophylaxis regimens does seem to be a problem world wide. According to Seymour et al (2000), compliance to recommended antibiotic dose, identifying “at risk patient” and providing cover for the appropriate dental procedure range from 15-35%

**Antibiotic Prophylaxis for Cardiac Conditions**

The results demonstrate that there is a tendency to use antibiotics unnecessarily in some cardiac conditions. More than 10% of surveyed dentists prescribed antibiotics for patients who have old myocardial infarction where antibiotic prophylaxis is not recommended and there is a tendency to prescribe antibiotics for patients with pacemakers in which antibiotic prophylaxis is not recommended. These findings are similarly reported by Thompson et al who concluded that the knowledge of Welsh dentists regarding cardiac conditions varied widely.

**Dental Procedures Requiring Antibiotic Prophylaxis in Patients at Risk of Infective Endocarditis**

According to AHA Guidelines 2008, the antibiotic prophylaxis for patients at risk of I.E. is required if the dental procedures involve manipulation of gingival tissue or periapical region of teeth or perforation of oral mucosa.

There is confusion in the antibiotic prescription by surveyed dental practitioners who prescribed antibiotics for bleeding from trauma to the lip or oral mucosa and for orthodontic band placement for patients at risk of I.E. These findings are also reported by Thompson et al as there is a similar confusion among Welsh dentists as to which particular dental procedures required prophylaxis.

The results show that there is confusion as to which cardiac conditions require prophylaxis and for which particular dental procedures. There is a need to update dentists’ knowledge with the recent antibiotic guidelines and make these guidelines readily accessible by dentists and physicians as many dentists consult physicians regarding the need for prophylaxis and the application of current regimen before performing a dental procedure.

**CONCLUSION**

The results of this survey reflect the antibiotic prescriptions patterns of dental practitioners for therapeutic and prophylactic purposes and can be used as a basis to improve the current guidelines and introduce more detailed guidelines for various dental conditions. The results show that there is a large variation in the antibiotic prescriptions patterns for therapeutic and prophylactic purposes and there is confusion as to which cardiac conditions require prophylaxis and for which particular dental procedures. This study confirms that there is a need for educational intervention such as training intervention, revising and distributing the antibiotic guidelines, individual outreach visits and antibiotic audit to encourage the rational and appropriate use of the antibiotics.

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Refining Occlusion With Muscle Balance To Enhance Long-Term Orthodontic Stability

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ABSTRACT
The primary objective of orthodontic treatment is the movement of teeth into a more ideal relationship, not only for aesthetic, but also for functional considerations. Another very important objective, often not given enough consideration, is the need to finish the case with the muscles of mastication in equilibrium. If muscle balance is not achieved, an endless procession of retainers, is required for retention. In simple terms, if the occlusal forces in maximum intercuspation are unevenly distributed around the arch, tooth movement will most likely occur. However, today it is possible to precisely measure the relative force of each occlusal contact, the timing of the occlusal contacts and specific muscle contraction levels, all simultaneously. This technological breakthrough represents a new opportunity for orthodontists everywhere.

Key Words:

INTRODUCTION

Muscle Balance and Occlusion

Many well respected orthodontists agree that there is more to occlusion than just “teeth.” Temporomandibular joint function and the maxillomandibular relation are as much a part of occlusion as are the teeth. Consequently, when a malfunction occurs within the TM joints or a maxillomandibular mal-relation exists, a compensatory response is elicited from the stomatognathic musculature. Most often that response can be measured through electromyography (EMG).

Over 50 years ago one orthodontist began to record muscle activity through surface electromyography in an effort to better understand the functions of the muscles of mastication. In the intervening years since, surface EMG has revealed several key facts about the relationship between the muscles and a patient’s occlusion. Today we can routinely record up to 8 channels of EMG data, right in the clinic. And, data interpretation can lead us to a better understanding of our patient’s specific condition.

Figure 1: An 8 channel Electromyograph
Figure 2: a) relaxed, quite muscles  b) hyperactive muscles  c) large motor-unit firing

In figure 2, we see muscles that are; a) relaxed at rest (the normal condition) b) hyperactive at rest (indicating a maxillo-mandibular malreletion) or 3) exhibiting a neurological abnormality (large motor-unit firing). While these factors routinely go unmeasured, their contribution to a precise diagnosis can be highly significant, even to the long-term outcome of a particular case.2-5

Figure 3. a) balanced clench  b) unbalanced clench  c) normal swallow  d) aberrant swallow

If we see that the muscles are balanced, we know we have a result that will remain stable. But, if the muscles are not in balance, we can’t tell from the EMG recordings along exactly what to do about it. While much has been learned about muscle hyperactivity and the various conditions of imbalance that can exist within the masticatory musculature, EMG is not, nor will it likely ever be, adequate to the task of directing case treatment by itself. While surface EMG is a fast, easy and reliable way to record the relative contraction levels of the muscles at rest or in function, it has a low sensitivity to occlusal force locations and the timing of tooth contacts.

T-Scan II

The simplest solution to the problem of evaluating the timing and force of occlusal contacts is the T-Scan II.21-23 It provides a very sensitive measure of contact force and a moving picture of the order in which the contacts occur.24-32 It is the only technology available to the clinician that can show precisely the order in which contacts occur and simultaneously, the relative force of each distinct contact. The new high density sensors are flexible, more precise and very durable (usable for up to 30 registrations).

A bite-force recording is taken by having the patient bite down several times on the T-Scan wafer to condition it. This allows it to conform to the shape of the arch. Then a recording is taken with the patient closing from rest position into the intercuspal position, followed by a clench. Other recordings can also be taken in centric relation, lateral excursions and protrusion.

Figure 4: The T-Scan II
A Map of the Sequence from Initial Anterior Contact to Bilateral Contact

![Image of A Map of the Sequence from Initial Anterior Contact to Bilateral Contact]

**Figure 5:** a) 1st contact  
In the recording in Figure 5, the initial contact points occur only on the incisors. As the patient continues to close a contact appears on the right area of the second molar. Eventually a contact appears on the left second molar creating a tripod effect.

b) 1st Posterior Contact  
c) 1st Left Posterior Contact

**Figure 6:** Force movie frames

When the recording is replayed as a “force movie” a three dimensional graph is displayed showing the relative force at each point of contact. Again we see that the initial contacts are on the incisors, then the right posterior and finally the left second molars. What is also evident is that in full closure, the highest contact force is actually on the left second molar, (indicated by the tallest spike) despite the lateness of the contact. Further inspection clearly suggests that the reason the excessive force is being born by the left second molar is due to a lack of solid contacts on the left first molar and bicuspids. In spite of the large number of contact points around the arch, this is an occlusion badly in need of adjustment.

However, as we analyze the tracing above, as clear as the picture of occlusion of this case is, we realize that we do not and cannot from this information understand what the musculature is doing to accommodate. But there is a way to do both.

**Why the T-Scan wafer at 85 microns is not too thick.**

According to the latest research on mandibular function (Gallo et al) we now know that the sagittal path of closure is more complicated than a simple hinge movement. In fact, the “helical axis of rotation” moves from the vicinity of the angle of the mandible (early in opening) to about mid-ramus (late in opening) in close proximity to where the inferior alveolar nerve enters the mandibular foramen. For a voluntary closure between rest and occlusion (2 - 3 mm) the average amount of rotation has been measured at 0.7 degrees (Lewin A. and Moss C.). For an 85 micron change that's about 0.02 degrees of rotation (about 1.5 minutes of arc). If the A/P distance between the incisors and the 2nd molars is 40 mm, 1.5 minutes of arc translates to an 18 micron difference in This is a very small difference in comparison to the size of an occlusal adjustment being made and well within the adaptive capacity of the system. Another benefit of placing the T-Scan wafer between the arches ... it that it reduces the acuity of proprioception, which reduces, but doesn't eliminate, the ability of the central nervous system to avoid any existing prematurities.
T-SCAN II – BioEMG II

Previous studies have attempted to correlate T-Scan data with EMG data. Recently the two companies who separately manufacture the T-Scan II and the BioEMG II have created a milestone by making their programs talk to each other. This is not something that happens often in dentistry, but the synergy created now offers a unique opportunity for dentists to more clearly understand their patients’ occlusal conditions comprehensively. The reason that the programs needed to talk to each other was to synchronize their respective data streams. This is accomplished by having either program act as a “master” while the other program acts as a slave to it. That is, a dentist can ‘Run” the T-Scan program and the BioEMG II program will dutifully “follow” it. Or, he/she can “Run” the BioEMG II program and the T-Scan II program will follow it. This is true in recording as well as in playback analysis.

![Figure 7: The Simultaneous Recording of Occlusal Force, Timing and Muscle Activity- One high force point on the left bicuspsids, right anterior temporalis hyperactivity](image)

Analyzing the Combined Traces

When we see that the highest force of contact is on the left can we assume that the greatest muscle activity will be the same? Not at all. Figure 7. shows an example of a patient with a higher force level on the left side (63% of total), focused in the bicuspid area. At the same time we clearly see that the right anterior temporalis is firing at nearly twice the level of the left one. It is also apparent that the combined activities of the right masseter and temporalis are far greater than the same muscles on the left. How is this possible?

Not one of the muscles of mastication that elevates the mandible is positioned such that there is a straight vertical relationship between the origin and the insertion. Each elevator muscle has a horizontal component to its direction of applied force. Due to the ginglymo-arthroidal structure of the temporomandibular joints, the mandible is able to move freely forward and back, left and right. The same “elevator muscles” that apply vertical forces can and do apply horizontal forces to the mandible as needed for function. In figure 7. then, we can see that while the left side muscles are applying more force in the vertical direction, the right side temporalis must be applying a significant amount of its force in a non-vertical (horizontal) direction. However, with some extra effort, it is possible to achieve a muscle and force balanced occlusion. See Figure 8.
Figure 8: Both the forces and the activities of the muscles are balanced in this patient

Balanced Forces do not Guarantee Balanced Muscles

Sometimes we can record a relatively even balance of forces between the right and left sides, but the patient is still not comfortable. Even with adequate stable contacts on both sides some patients still complain. The patient in Figure 9. had regular temporal headaches. The left-right force balance was rather good at 56% right to 44% left. It is evident that the initial contact is on the left side (see the center of force vector), that during the closure the force passes to the right side before reaching its balanced force condition at maximum intercuspation. However, notice that the temporals are contracting 2½ times greater levels than the masseter muscles. Soon after a repositioning appliance was placed that balanced both the muscle and the forces, the headaches were relieved.
Figure 9: By the time the total force has reached 93.5% of maximum, the center of force has returned to the midline and the vertical muscle forces are even between left and right sides. However, it is clear that the temporalis muscles are “overloaded” compared to the masseters.

With the technology that is available today an ordinary practicing dentist has the ability to more thoroughly evaluate the masticatory system than ever before. It is now possible to routinely adjust an occlusion, not only to equalize the occlusal forces, but also to create an environment where the muscles can function in harmony with each other.

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Microleakage Of Class II Cavities Restored Using Composite Resins

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ABSTRACT

Objectives: To evaluate the marginal microleakage of Class II cavities restored with various types of composite resins. Materials and Methods: Standard Class II slot cavities were prepared at the proximal surfaces of 40 intact premolars which were divided into 4 groups. Four types of composite resins (Esthet-X-Denstply, USA, FiltekTMZ350-3M ESPE, USA, Beautifil- Shofu, Japan and Solare P-GC, Japan) were used to restore the slot cavities. All the specimens were thermocycled and immersed in 0.5% basic fuschin dye for 24 hours. The specimens were then sectioned in mesio-distal direction. The marginal microleakage at the occlusal and cervical margin was scored using the ISO microleakage scoring system. Data was entered using SPSS Version 12.0 and analyzed using STATA software programme. Results and discussion: All composite resins exhibited worse microleakage at the cervical margin compared to occlusal margin. Esthet-X showed significantly better microleakage score at the occlusal margin compared to Beautifil and Solare P. FiltekTMZ350 and Beautifil showed mainly microleakage into enamel only at the occlusal margin. Solare P demonstrated better resistance against microleakage at the cervical margin compared to other composite resin tested. Esthet-X, Filtek Z350 and Beautiful is not significantly different from each other in terms of microleakage at the cervical margin. Conclusion: This study showed that none of the materials used in this study is able to eliminate microleakage. Composite resin restorations exhibited worse microleakage at cervical margin in comparison to occlusal margin.

Key Words: Microleakage, composite resin, Class II cavities, occlusal margin, cervical margin

INTRODUCTION

Composite resins have gained popularity in the last decade and have been used in the posterior region as direct or indirect restorations. This tooth-coloured restorative material is a popular substitute to replace amalgam and metallic restorations due to fear of mercury toxicity, aesthetic concern and conservation of tooth structure.

The clinical longevity of posterior composite resin restorations still poses a concern. In the past years, many studies have been carried out to evaluate the physical and mechanical properties of various composite resins. Improvements in its filler technology and resin matrix have increased its used in the posterior stress-bearing areas. Although the physical and mechanical properties of composite resins have improved, polymerization shrinkage remains one of the major concern leading to failure of direct composite resin. Polymerization shrinkage results in the formation of microscopic marginal gap at the tooth-restoration interface which increase the risk of secondary caries formation, marginal staining and post-operative sensitivity. These may subsequently lead to failure of the restoration and development of pulpal pathology. Therefore, it is important to minimize or eliminate microleakage to ensure longevity of the restorations. This in vitro study aims to evaluate the marginal microleakage in Class II cavities restored with various types of composite resins. The microleakage at occlusal and cervical margin was evaluated.

MATERIALS AND METHODS

Forty intact and non-carious maxillary premolars extracted due to orthodontic treatment or periodontal problems were collected. Class II slot cavities were prepared on the mesial proximal surface of the 40 premolars (Figure 1). The cavities have standard depth of 2.0mm and 3.0mm in bucco-palatal width. The cervical margin of the cavities is placed 1.0mm below the cemento-enamel junction (CEJ) (Figure 1). The teeth were randomly divided into four groups with 10 specimens in each group.
Four types of composite resins were used to restore the prepared cavities: (1) Esthet-X (Dentply Caulk, USA); (2) Filtek™Z350 (3M ESPE, USA); (3) Beautifil (Shofu Dental Corporation, Japan) and (4) Solare P (GC Corporation, Japan). The cavities were etched and bond using the respective company’s dentine bonding agents and following the manufacturer’s recommendations. The composite resins were adapted using narrow silica matrix band to ensure appropriate contouring of the material at proximal areas. The restorations were cured incrementally according to the manufacturer’s instructions using a light curing device “Spectrum 800” (470 nm wavelength) (Dentply Caulk, USA). This device has a built-in, digital radiometer that is able to confirm the light unit output. The occlusal and proximal surfaces of the restorations were finished using the medium and fine Soflex disc (3M ESPE, USA).

![Figure 1: Class II slot cavity on mesial surface](image)

All the specimens were thermocycled at 5°C and 55°C for 500 cycles. Two layers of varnish were then applied 1.0mm away from the cavity margins prior to immersion in dye for microleakage evaluation to avoid leakage of dye through other channels. The specimens were immersed in 0.5% basic fuschin dye for 24 hours. All the specimens were then rinsed with distilled water and dried. Two mesio-distal sectioning were obtained and dye penetration on both surfaces of the middle section was evaluated and the worst score for dye penetration was taken for data analysis. The extent of the microleakage was scored using image analyser. The ISO microleakage scoring system (ISO/TS 11405:2003) was used to record the extent of microleakage as in Table 1.

<table>
<thead>
<tr>
<th>Occlusal Score</th>
<th>Cervical Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score 0</td>
<td>No dye penetration</td>
</tr>
<tr>
<td>Score 1</td>
<td>Dye penetration into enamel</td>
</tr>
<tr>
<td>Score 2</td>
<td>Dye penetration into the dentine, not including the pulpal wall/gingival floor</td>
</tr>
<tr>
<td>Score 3</td>
<td>Dye penetration into the dentine including the pulpal wall</td>
</tr>
<tr>
<td>Score 4</td>
<td>Dye penetration into cervical and axial wall</td>
</tr>
</tbody>
</table>

**Table 1: Scoring system for the extent of microleakage**

RESULTS

Table 2 showed the microleakage score at the occlusal and cervical margins of the specimens. Fisher Exact Test was carried out to compare the microleakage in the Class II slot cavities at the occlusal and cervical margins (Tables 3 & 4). It showed that in general the occlusal margin demonstrated better microleakage score than at the cervical margin; with most specimens having no leakage or only leakage into enamel at the occlusal aspect while most specimens have leakage into the whole of cervical wall and also axial wall at the cervical aspect. At the occlusal margin, Esthet-X demonstrated the least microleakage with nine specimens scored no leakage in comparison to other groups (Figures 2 & 4). Esthet-X showed significantly better microleakage score at the occlusal margin compared to Beautifil and Solare P (Table 3). Filtek Z350 is not significantly different from Esthet-X in terms of microleakage at the occlusal margin (Table 3). Solare P exhibited the highest frequency of specimens showing dye penetration or microleakage extends into the dentine including the pulpal wall. Filtek™Z350 and Beautifil showed mainly microleakage into enamel only at the occlusal margin (Figures 2, 6 & 7).

It was found that the microleakage pattern at the cervical margin showed a different scenario with Solare P having better resistance against microleakage.
Microleakage of Class II cavities restored using composite resins

at the cervical margin compared to other composite resin tested; i.e four of the Solare P specimens showing no leakage (Figure 3). Interestingly, Esthet-X which demonstrated good microleakage score at occlusal margin has become the worst with all of the samples having microleakage into cervical and axial wall (Figure 3). Pos hoc test revealed that the microleakage score for Esthet-X at the cervical margin was significantly worse than Solare P (Table 4). Esthet-X, Filtek Z350 and Beautiful were not significantly different from each other in terms of microleakage at the cervical margin (Table 4).

Table 2: Microleakage score at occlusal and cervical margin

<table>
<thead>
<tr>
<th>Type of composite resins</th>
<th>n</th>
<th>Occlusal margin</th>
<th>Cervical margin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0 1 2 3</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Solare P</td>
<td>10</td>
<td>1 5 0 4</td>
<td>4 2 1 3</td>
</tr>
<tr>
<td>Beautiful</td>
<td>10</td>
<td>1 8 0 1</td>
<td>0 0 9 0</td>
</tr>
<tr>
<td>Filtek Z350</td>
<td>10</td>
<td>1 9 0 0</td>
<td>0 0 2 8</td>
</tr>
<tr>
<td>Esthet-X</td>
<td>10</td>
<td>9 1 0 0</td>
<td>0 0 0 10</td>
</tr>
</tbody>
</table>

Table 3: Pos hoc test for pairwise comparison a for microleakage at the occlusal margin

<table>
<thead>
<tr>
<th>Pairwise comparison</th>
<th>Esthet_X</th>
<th>Filtek Z350</th>
<th>Beautiful</th>
<th>Solare P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esthet_X</td>
<td>NS</td>
<td>&lt;0.001</td>
<td>&lt;0.001</td>
<td></td>
</tr>
<tr>
<td>Filtek Z350</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Beautiful</td>
<td>&lt;0.001</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Solare P</td>
<td>&lt;0.001</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

a. Fisher Exact Test with Bonferroni correction was done, significant at p < 0.05

Table 4: Pos hoc test for pairwise comparison a for microleakage at the cervical margin

<table>
<thead>
<tr>
<th>Pairwise comparison</th>
<th>Esthet_X</th>
<th>Filtek Z350</th>
<th>Beautiful</th>
<th>Solare P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Esthet_X</td>
<td>NS</td>
<td>NS</td>
<td>0.018</td>
<td></td>
</tr>
<tr>
<td>Filtek Z350</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Beautiful</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
<tr>
<td>Solare P</td>
<td>0.018</td>
<td>NS</td>
<td>NS</td>
<td></td>
</tr>
</tbody>
</table>

a. Fisher Exact Test with Bonferroni correction was done, significant at p < 0.05
DISCUSSION

This study was conducted to evaluate and compare the extent of marginal microleakage in Class II slot cavities restored with four different types of composite resins: Esthet-X, Filtek™ Z350, Beautifil and Solare P. Class II restorations were chosen due to the increased demand for posterior composite resin restoration.

Microleakage at cervical margin of Class II restorations has been a problem and remains one of the main causes for failure of posterior composite resin restorations. Numerous researches on microleakage have been carried out with a view to improve the performance of various restorative materials in clinical service. Yazici et. al. (2004) have mentioned that differences in the results may be related to the different types of materials used, the location, type and size of the cavities, the operator factors (i.e. professional skills during the restorative procedures) and research methodology. Fraunhofer et. al. (2000) also stated that various tooth preparation has influence on the microleakage behaviour. It is therefore difficult to make direct comparison amongst various research findings. Nevertheless, the findings in this study can serve as a guide to the extent of microleakage that will occur with the materials investigated.

Microleakage is a three dimensional phenomenon, different location and angles of sectioning may result in a different degree of dye penetration. Gwinnet et. al. claimed that the amount of microleakage in a single section will be underestimated. In the present study, two mesio-distal sectioning were obtained and dye penetration on both surfaces of the middle section was evaluated and the worst score for dye penetration was taken for data analysis. It is hoped that by doing so more representative scores would be obtained. Precautions have been taken to reduce the errors in measurement, evaluation was carried out by one assessor (to eliminate inter examiner variability) and the set up of the image analyzer was standardized.

In general, the composite resins investigated in the present study (Esthet-X, Beautifil and Filtek™ Z350) demonstrated more microleakage at the cervical margin compared to occlusal margin. This finding is similar to findings by other researchers. Leevaloj et. al., (2001) used four different types of packable composite resins (Alert-Jeneric, Surefil-Dentsply, Pyramid-BISCO and Solitaire-Heraeus Kulzer) and one conventional composite resin (Renew-BISCO) with their respective manufacturer’s bonding agent and they found that significantly higher leakage was noted at the cervical margin in Class II cavities with cervical margin placed 1mm below the cemento-enamel junction. Peutzfeldt & Asmussen (2002) also demonstrated higher leakage at the cervical margin than the occlusal margin when Class II cavities were restored with hybrid composite resin (Renew).

Esthet-X was highly viscous and difficult to adapt to the tooth surfaces. This may have attributed to the high degree of leakage at the cervical margin. The high viscosity also resulted in the observation of voids in the body of Esthet-X materials when viewed under image analyser with 2.0 X magnification. The presence of
voids in a material may be due to the resin properties such as high viscosity, polymerization shrinkage, high modulus of elasticity, poor wettability and the depth of cure. This may lead to lower resistance to fatigue and decreased wear resistance. The voids may be detected on radiographs and voids that present at the margin may be responsible for marginal discoloration and gross microleakage. At the occlusal margin where visibility is good, the marginal adaptation can be improved by burnishing the material.

It was also found that majority of Solare P specimens had dye penetration into half of the dentine and pulp wall at the occlusal margin. The poorer microleakage score for Solare P may be due to the inability of the self-etching primer to adequately etch the enamel surface. Generally the self-etching primers use weaker acid with pH range from 1.8 to 2.5. The separate acid etching step used for Esthet-X and Filtek™2350 may effectively etch the enamel to form resin tags and contribute to less microleakage.

On the other hand, Belli et. al. (2001) found that there was no significant difference at the interfaces tested (occlusal enamel-resin, cervical enamel-resin and dentin-resin) with different etchant. They found that the used of 37% phosphoric acid on the enamel surface did not produce better seal compared to the used of self-etching primer. Indeed, a study carried out by Pashley (1992) revealed that self-etching primer actually has the ability to bond well to roughen or prepared enamel but not to unprepared enamel, and the unprepared enamel must be etched first with standard phosphoric acid. Furthermore, Oliveira et. al., (2003) showed that self-etching primer yielded higher bond strength than total-etch system regardless different surface preparation methods. However, whether higher bond strength was related to lower microleakage is not known.

At the cervical margin, Solare P showed less extent of microleakage where only three of the specimens showed penetration of the dye into the cervical and axial wall compared to the other types of composite resin tested. In contrast, Esthet-X demonstrated the worst microleakage which resulted in dye penetration into the cervical and axial wall for all specimens. This is because at the cervical margin, there was absence of enamel prism and therefore less mineralized than at the occlusal margin. This has resulted in less predictable etching pattern and more microleakage. In the present study, Solare P demonstrated lower leakage at the cervical compared to other composite resins probably due to the ability of the weaker self-etching primer in producing a conducive etch pattern at the cervical margin compared to the stronger phosphoric acid.

A study done by Pashley (1992) noted that the present of smear layer and smear plugs are able to reduce dentine permeability and removing this layer may have resulted in increased dentine permeability. This observation may explain the worse microleakage score in Esthet-X at the cervical margin. On the other hand it may also explain the least microleakage score in Solare P. The self-etching primer did not totally remove the smear layer in comparison to the total etch technique. Therefore the tubules remain sealed. However, to confirm this, further study should be done at microscopic level.

CONCLUSION

Within the limitations of the present study, it is concluded that composite resin material exhibited better marginal seal at occlusal margin in comparison to cervical margin. In this study, Esthet-X has demonstrated better marginal seal at occlusal margin compared to other composite resin investigated. If margin of cavity is very deep and subgingival, placement of cavity margin below the CEJ may affect the longevity of the restoration due to high incidence of microleakage.

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