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Oral cancer is the fifth most common cancer in the world and it is estimated that over 640,000 new cases will be identified worldwide on a yearly basis. The occurrence of oral cancer is particularly high among men, the eighth most common cancer worldwide (Peterson 2003). In South-Central Asia, 80 per cent of head and neck cancers are found in the oral cavity and oropharynx and it accounts for up to 40% of all malignancies (Parkin et al, 1999). Oral squamous cell carcinoma comprises over 90 per cent of the malignancies beginning as inflammatory lesions such as leukoplakia, erythroplasia, and erythroleukoplakia (Silverman 2001). In Vietnam, 19.80% of all malignant neoplasms are diagnosed as oral cancer (Tran et al., 2006). In most regions of India, it is the most common cancer in men and the third most common cancer in women (Nair et al., 2012). In Myanmar, oral cancer ranks 6th in males and 10th in females and contributes 3.5% of whole cancer (Htun Naing Oo et al., 2011).

The WHO Global Oral Health Program is committed to work for country capacity building in oral cancer prevention, inter-country exchange of information and experiences from integrated approaches in prevention and health promotion, and the development of global surveillance systems for oral cancer and risk factors. WHA60 A16 URGES Member also stated to take steps to ensure that prevention of oral cancer is an integral part of national cancer-control programs, and to involve oral-health professionals or primary health care personnel with relevant training in oral health in detection, early diagnosis and treatment (www. who.int/oral_health).

In communities throughout Southeast Asia, oral cancer including oral squamous cell carcinoma has been predominantly related to traditional areca nut use. The World Health Organization has reported the use of betel quid as a widespread global risk habit that has spread due to increased migration of Asian communities to all continents resulting in increases in oral cancers around the globe. Betel quid chewing (smokeless tobacco) is a known risk factor for oral leukoplakia, oral submucous fibrosis, and oral squamous cell carcinoma. The evidence that smokeless tobacco causes oral cancer was confirmed recently by the International Agency for Research on Cancer (IARC) (Cigliano et al., 2004). Consequently, public health concern of a worldwide epidemic of oral cancer relates to the use of betel quid and its substitutes by an increasing number of young adolescents (Swerdlow et al., 1995).

Despite many advances in surgical techniques and rehabilitation, there have been no improvements in survival of oral cancer patients for decades. Combined with our knowledge of the risk factors for oral cancer, and possibilities for health promotion and education, has major public health implications. The low level of health literacy of oral cancer patients has been related to extreme patient load, lack of time for health care professionals and lack of human resources. People are also frightened and confused about their disease perceiving oral cancer as a contagious disease (Bruce 2004). Therefore, a multidisciplinary approach to oral health care of cancer patients is required and access to public oral health care education is part of that approach. Many concepts of this education have unclear boundaries between access and demand, between health states and health care and between perceived individual need and social responsibility (Maupome et al., 2001).

General dentists have been providing these services to their patients for decades now and have been able to keep patients healthy by detecting many lesions that would have gone undetected and untreated, resulting in more severe problems. Dentists are in a position to detect oral cancer lesions early and make a big
difference in the treatment. Nevertheless, primary oral health care professionals collaborate with primary care physicians assume a frontline role in the battle against oral cancer.

It can be concluded that dentists have a key role to play in the early detection of oral cancer and in the prevention of the disease by identifying those patients who are exposed to risk factors. The examination is quick and painless and by taking this opportunity to do something that could save the life. Furthermore, the association of betel quid use with the increase of precancerous conditions and oral cancerous lesions highlights the importance of education not only on tobacco cessation and less alcohol consumption but also on betel quid cessation. Therefore, collaborative and constant effort is essential to increase awareness by active preventive educational approach, counseling with the aim to prevent or improve outcomes through early diagnosis and implementation of appropriate treatment.

Our special interest group of Oral Medicine and Oral Pathology initiated the Oral Cancer Awareness Program on Oral Cancer Awareness Month, April 2013 by screening among tobacco and betel quid consumers at suburban and rural areas of Yangon Division. We would welcome comments from interested individuals, organizations from country wide to collaborate in Oral Cancer Awareness Program aiming towards reduction in morbidity and mortality related to this non communicable disease.

References:


Use of lasers in everyday dental practice

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Abstract
Since the development of the ruby laser by Maiman in 1960, it has been efficiently used for diagnostics, surgery and therapeutic applications in dentistry. With expansion in future application of lasers in modern dentistry, it is expected that number of potential laser users will continue to grow. Therefore, the aim of this review is to present some of the wide range of possible dental treatment options, which can be successfully accomplished employing lasers, either used alone or in combination with conventional therapy approaches.

Key words/terms: “laser”, “dental lasers”, “lasers in dentistry”

Introduction
Laser is an acronym for “Light Amplification by Stimulated Emission of Radiation”. The first device, ruby laser, was created in 1960 by Maiman and since then it has been efficiently used for diagnostics, surgery and therapeutic applications in dentistry (Brighton et al., 1997). Laser light is collimated, monochromatic and coherent (Ishikawa et al, 2009). These basic characteristics are making advantageous biologic properties of lasers, namely possibility to perform treatment options beyond those available via conventional techniques.

Lasers, in general, consist of an active medium and a pumping source enclosed in optical cavity. Based on the active lasing medium, it can be divided on gas, a solid state crystal lasers, diode, excimer and dye lasers (Table 1). Further, lasers can be divided according to their maximum output energy level on soft lasers (low output) and hard lasers (high output) (Aoki et al., 2008). The specific interaction between laser light and biological tissue is determined by the wavelength of the laser. Because of monochromacity of laser energy, different laser wavelengths have different absorption coefficients when in contact with dental tissue. Because human dental tissues are composed of a combination of water, apatite crystal, blood and tissue pigment, the dentist must choose the best wavelength of laser for each and every treatment. For soft tissue treatment, dentist can use any dental laser regardless of wavelength, because all dental lasers are absorbed by one or more of the soft tissue components. For hard tissue surgery, however, the only lasers to be selected are from erbium family (Er:YAG and Er,Cr:YSGG), since they can easily ablate layers of calcified tissue without any thermal effects.

Low-level laser irradiation (LLLI; low-level laser therapy-LLLT, photo-bio-modulation) is considered to be a certain amount of energy that scatters and penetrates into the surrounding tissues and cells simultaneously during high-level laser irradiation (Fig. 1). Recently, laser systems with power and energy densities below the destructive level have been introduced („pure“ LLLI). LLLI causes analgesia and cell/tissue biostimulation (e.g. increase of systemic microcirculation and tissue oxygenation, cell metabolism and/or tissue regeneration and potential tissue healing) without
Lasers are successfully used in surgical (ablative) and non-ablative (LLLT) manner. In ablative manner lasers are used to remove as much of oral tissue as possible. Patients are feeling mild warmth on the targeted place; therefore in most of the cases anesthesia is required prior to irradiation, as a part of surgical procedure (Pavlic & Vujic-Aleksic, 2013). One of the biggest concerns in ablative manner is laser-related hazard-plume (having a potential for carrying viral particles). In contrast to ablative lasers, LLLT is non-destructive, non-thermal and pain free procedure, which usually does not require anesthesia and do not carry any potential of plume hazard to the surgeon and personnel. Further, it does not produce visual effects of thermal damage to the oral mucosa such as ablation, coagulation, vaporization or erythema (Pavlic & Vujic-Aleksic, 2013).

To date, laser dentistry is still not fully incorporated in everyday dentistry, mainly due to the high costs of laser devices. With expansion in future application of lasers in modern dentistry, it is expected that specific laser technologies will become an essential component of contemporary dental practice with increased number of potential laser users. Therefore, the aim of this review is not intended to be a comprehensive literature review but rather presentation of possible dental treatment options, which can be successfully accomplished employing lasers, either used alone or in combination with conventional therapy approaches.

Lasers in periodontology

Lasers are used in periodontology as a treatment modality for soft and hard tissue surgery as well as non-surgical treatment that have been proven by a wide range of researchers. Lasers (CO2, diode, Nd:YAG lasers), which are used for treatment of soft tissues (frenectomy, gingivectomy, gingivoplasty) can ablate oral soft tissues easily and promote hemostasis by coagulating and occluding small blood vessels instantly, making surgical area clearly visible and bloodless. Further, surgery done by lasers reduces pain, swelling and wound contraction. But since periodontium is made from hard and soft tissues, recently introduced erbium lasers left the possibility to treats both, soft and hard tissues, without major thermal damages (Aoki et al., 2008; 2000). Therefore, erbium lasers are considered the most promising laser devices in periodontology.

Frenectomy

Labial frenulums are occasionally inadequate in size or location, leading to functional and esthetic limitations. Laser frenectomy can be successfully done by any dental laser regardless of wavelength and with significant reduction of surgical time in comparison with conventional surgery. Laser frenectomy does not require anesthesia prior to surgery, reduces pain and bleeding during surgery, avoids the need of suturing and special postoperative care (Pié-Sánchez et al., 2012).

Gingivectomy/Gingivoplasty (soft tissue crown lengthening)

Laser gingivoplasty or gingivectomy can be successfully performed for the excision of the soft-tissue wall of the periodontal pocket, for elimination of suprabony pockets after adequate initial preparation, for easy access in the presence of suprabony pockets and in case of gingival overgrowths, either asymmetrical or unesthetic (Shankar et al. 2013).

Non-surgical periodontal therapy

Periodontitis is chronic inflammatory disease caused by bacterial infection, that in later stages involves progressive loss of alveolar bone, and if left untreated can lead to subsequent tooth loss. Some of the advantages of employing erbium lasers include: successful calculus removal, its bactericidal and detoxifying effects, reducing of inflammation and faster healing of periodontal pockets through elimination of bacteria (Moritz et al., 1998), resulting in better therapy outcome, such as reduction of periodontal pocket depth and clinical attachment level gain (Aoki et al., 2008). Water irrigation during Er:YAG laser irradiation is considered essential to eliminate thermal side-effects on the root surface. In most of the cases, lasers are described as an adjunct to rather than a replacement for conventional therapy (mechanical debridement).

Regenerative periodontal surgery

Periodontal therapy is characterized by debridement of root surface and successful removing of diseased granulated tissue from the bone defect, correction of the alveolar bone and surgical field disinfection. For this purpose, Er:YAG laser is considered optimal due to ability to vaporize bone tissue efficiently without major thermal side effects (Ishikawa et al., 2000-2009; Aoki et al, 2008). Recently, American Academy of Periodontology concluded that “…the Er:YAG laser
demonstrated the best application of laser use directly on hard tissue, leaving the least thermal damage and creating a surface that suggest biocompatibility for soft tissue attachment. Studies have demonstrated the ability of the Er:YAG laser to remove lipopolysaccharides from root surfaces, facilitate removal of the smear layer after root planning and remove calculus and cementum...” (Research, Science and Therapy Committee of the American Academy of Periodontology, 2002). Further, recently introduced dual-wavelength technique (CO2 and Er:YAG lasers) left the possibility to use the most beneficial characteristics of both laser systems (Er:YAG for debridement and disinfection and CO2 for de-epithelization) in tremendous promise in regenerative periodontal surgery.

**Lasers in oral surgery, oral pathology and oral medicine**

The fields of oral surgery, oral pathology and oral medicine are having a great benefit from laser use. We can also successfully combined use of laser with conventional techniques.

**Removal of drug-induced gingival hyperplasia**

Hyperplastic gingiva usually occur secondary to use of anti-hypertensive drugs (e.g. calcium channel blockers), anticonvulsants and immunosuppressant (e.g. cyclosporine). Even though any laser wavelength can be used to successfully ablate gingival tissue and accomplish this procedure, CO2 laser with excellent coagulative abilities is consider optimal (Muralikrishna et al., 2013).

**Treatment of recurrent aphthous stomatitis**

Recurrent aphthous stomatitis (RAS) is described as multifactor immunologic inflammatory lesion in the oral cavity, characterized by painful, recurrent single/multiple shallow ulcerations of mucosal tissues. In the treatment of painful RAS lesions, lasers are successfully used in surgical (ablative) and non-ablative (LLLT) manner. In ablative manner, any laser is used to remove as much of necrotic RAS tissue as possible, including the inflamed halo around the aphthae (Colvard & Kuo, 1991). When employing LLLT, scanning over RAS lesion at the distance of 5-7 mm (circular motion) for about 5-10 seconds is suggested (Zand et al., 2012).

**Treatment of herpetic lesions**

Herpetic lesions are characterized with painful ulcerative erosions caused by herpes simplex virus type 1 (HSV-1). Treatment of herpetic lesions can be accomplished with LLLT regardless of wavelength (diode, Er:YAG, Nd:YAG, CO2), mainly due to abilities to speed up the wound healing process and cause significant analgesia while reducing the number of recurrences. Lasers are used in non-contact mode at the distance of 5-6 mm from herpetic lesions. It is particularly useful for elderly patients, due to the low frequency of side effects (Schindl & Neumann, 1999).

**Oral lichen planus/ Premalignant lesions**

Oral lichen planus (OLP) is chronic immunologic mucocutaneous inflammatory disease of oral mucosa. CO2 laser is proven to be useful and effective in fast and easy ablation of OLP lesion, with no need for suturing. Further, faster healing process was uneventful with minimal post-operative discomfort, minimal pain, swelling or bleeding and without visible scarring. Also, LLLT namely for biostimulation and analgesia of painful OLP lesions was suggested (Pavlic & Vujic-Aleksic, 2013).

**Pemphigus Vulgaris**

Pemphigus vulgaris is an autoimmune bullous disease of the skin and mucosa that leads to flaccid blisters and painful multiple erosions. Lasers (ablative/non-ablative) can be used either alone or combined with conventional treatment modalities, such as topical corticosteroids (Bhardwaj et al., 2010). When used in low-level mode, CO2 and/or diode lasers are reported beneficial in therapy of PV lesions (Minicucci et al., 2012).

**Pericoronitis**

Pericoronitis is inflammation of the soft tissues surrounding the crown of a partially erupted tooth. Since it is primarily bacterial infection, use of lasers is considered beneficial in inflamed tissue removal compared to scalpel, namely due to documented bactericidal effects of lasers (Sezer et al., 2012).

**Gingival abscess**

Gingival abscess is caused by infection from microbial plaque, trauma and foreign body impaction. The laser instrument (Er:YAG laser, diode) is placed at the height of the fluctant mass and an incision is quickly made down to the bone, causing immediate drainage. That is usually resulted in resolution of the abscess and clinical wound healing within approximately 2 to 3 weeks (Prasad et al., 2011).

**Biopsy**

Lasers can be a useful treatment modality
for excisional biopsies of benign soft tissue lesions in the oral cavity. After local anesthesia is administered, the lesion is outlined with the diode, Nd:YAG, Er:YAG, Er:YSGG, or CO2 laser for incision of entire lesion, as well as some normal tissue surrounding the lesion (Bornstein et al., 2005). Since lasers will have peripheral thermal effect, it is recommended to enlarge the surgical incision, at least to around 0.5 mm in circumference, in order to make a histological diagnosis free from doubt or uncertainty. Biopsy sites are generally left to heal with no sutures (secondary intent).

**Lasers in operative dentistry**

**Detection of caries**

A major diagnostic application of low power lasers is the detection of caries, using fluorescence elicited from hydroxyapatite or from bacterial by-products. Laser fluorescence is an effective method for detecting and quantifying incipient occlusal and cervical carious lesions and with further refinement could be used in the same manner for proximal lesions.

**Class I-V restorations**

Many wavelengths of laser are available today, but not all are to be used for cavity preparation and removal of carious tissues. The erbium lasers (Er:YAG and Er:Cr:YSGG) in tooth preparation are considered optimal minimal invasive approach, since they are highly absorbed in water and, to a lesser extent, in hydroxyapatite. They remove caries in enamel and dentine by ablation, without effects of temperature rise on the pulp and without the risk of micro- and macro-fractures that have been observed with conventional rotating instruments. Some of the benefits of laser use during cavity preparation include: restricted or no need for anesthesia, selective and precise ablation of only decayed tooth structure (leaving surrounding healthy structure), smear layer free cavity walls, cavity walls with a higher acid resistance resulting in a better protection against secondary decay, sterilization and disinfection, and most of all, high patients acceptance (children and adults), and enhanced comfort (less pain, no heat or vibration). Use of lasers is having disadvantages, too. For example, erbium lasers can’t be used to remove metallic and porcelain restorations (Olivi & Genovese, 2011).

**Lasers in aesthetic dentistry**

**Gingival melanin hyperpigmentation and gingival discoloration removal**

Melanin hyperpigmentation often occurs in the gingiva as a result of an abnormal deposition of melanin. Gingival discoloration (metal tattoo) is iatrogenic discoloration of gingival tissue caused by metal particles (silver sulfate, tin sulfate and pieces of iron) that were embedded into the connective tissue during metal abutment preparation (3). Depigmentation by laser (Nd:YAG, Er:YAG, diode and CO2 laser) is demonstrated in vivo and clinically to be effective and safe therapy approach with uneventful healing and no repigmentation (Aoki et al., 2008; Murthy et al., 2012).

**Aesthetic crown lengthening**

The part of the tooth that is seen above the gum is called the clinical crown. When not enough of the clinical crown is showing, the gum must be moved up the root to expose more tooth. This is called crown lengthening and is successfully done with any laser, regardless of wavelength (Shankar et al., 2013).

**Laser-activated tooth whitening**

Laser dental bleaching, also known as laser tooth whitening is a common procedure in general dentistry, in which a hydrogen peroxide (bleaching) solution applied to the tooth surface is activated by laser energy, which speeds up of the whitening process (Mohammadi et al., 2011). So far, lasers of different wavelengths had been used for laser-driven whitening (Ar, diode, Er:YAG) without temperature increase (Sari et al., 2013). Additionally, common complaint following teeth whitening- teeth and gingival sensitivity was less followed by lasers (Mohammadi et al., 2011; Sari et al., 2013).

**Lasers in endodontics**

**Desensitization/dentin hypersensitivity**

Dentinal hypersensitivity is one of the most common complaints in clinical dental practice. However, since it is subjective complaint, objective evaluation of laser efficiency is a very difficult issue (Blatz, 2012). To date, clinical studies suggested safe and effective use of lasers in ablative (Nd:YAG, CO2) and non-ablative mode (diode, CO2, Nd:YAG, He-Ne).

**Root canal disinfection**

The use of lasers in aiding root canal disinfection is more promising than in root canal preparation. Nd:YAG, Er:YAG, CO2 and diode lasers are able to disinfect and decontaminate the treated tissues by destroying aerobic and anaerobic bacteria. Energy can be used directly or can be combined with a photosensitive chemical that, when bound to microorganisms, may be activated by low-energy laser light to essentially
kill the microorganism (Photodynamic Therapy-PDT). Currently many in vitro and in vivo studies suggested the antibacterial efficacy of high-power laser (Nd:YAG, Ho:YAG, Er:YAG, Er:Cr:YSGG) in root canals (Mohammadi, 2009; Cheng et al., 2012). Any laser wavelength can disinfect a root canal system. However, dentist must think of other endodontic treatment steps, when selecting the most appropriate laser wavelength to be employed.

Canal shaping/ Obturation of the root canal

Proper shaping of the root canal helps remove organic tissue and facilitate canal irrigation and obturation. In root canal treatment, lasers may be used to remove the dental pulp and organic debris, and to modify the dentinal walls by inducing melting and resolidification cycles resulting in the enlargement the walls of the root canal system. Once the preparation is completed, the root canal is obturated, and the laser (Nd:YAG, Er:Cr:YSGG, Er:YAG) may be used to soften and mold the obturating material to the prepared root canal system. Laser irradiation from apical to coronal surface in a continuous circling fashion is considered optimal technique. With the development of thinner, more flexible and durable laser fibres, laser applications in endodontics have increased (Mohammadi, 2009).

Apicoectomy

Apicoectomy is a surgical root canal procedure whereby the apex of a tooth’s root is trimmed and removed. Recently, an Er:YAG laser has attracted attention because of the possibility of cutting hard tissues with extremely small thermal effects. Laser clinical application for apicoectomy has many advantages including absence of discomfort and vibration, less chance for contamination of the surgical site, and reduced risk of trauma to adjacent tissue (Komori et al., 1997).

Lasers in implantology

Lasers are widely used to cut gingival tissue (even without anesthesia) and expose the implant body for the placement of suprastructure during the second phase of implant surgery. Use of lasers will improve hemostasis, enhance wound healing once abutments are placed and most importantly it will cause less patient discomfort during the operative and postoperative period (pain and edema). Furthermore, in vivo and clinical studies demonstrated benefits of Er:YAG laser by preparing fixture holes in bone tissue for successful implant osseointegration with less mechanical stress to the bone during surgery (Aoki et al., 2008; Schwarz et al., 2007).

Peri-implantitis

Peri-implantitis is defined as a localized lesion involving bone loss around an osseointegrated implant that can induce a breakdown of the implant-supporting bone. The main goals of the treatment of peri-implantitis are elimination of the peri-implant inflammation and stabilization of the bony attachment. Recently, in vitro and clinical studies supported use of some lasers in reduction of bacteria from contaminated gingiva and peri-implant pockets. For this purpose Er:YAG, diode and CO2 lasers seem to be safe and effective, while it has been demonstrated that Nd:YAG laser use is contraindicated since it can damage titanium surface of dental implants. On the other side, Er:YAG lasers could not be recommended in treatment of ailing implants, since the laser beam can penetrate the material. Further, concern regarding use of lasers is the heat generated at the titanium implant surface and/or peri-implant bone while diode and CO2 lasers are used (Aoki et al., 2008; Schwarz et al., 2007).

Lasers in Fixed Prosthodontics

Gingival retraction

Accurate recording of finish line is a very important parameter for taking the impression and successful prognosis of indirectly fabricated restorations. Soft tissue lasers can be used as a substitute to conventional retraction techniques, because they cause less bleeding and require less working time (Krishna et al., 2013).

Recontouring of the gingival margin and bone for crown lengthening

This is a periodontal procedure in which gingival and osseous tissue is removed in order to expose more clinical tooth structure (Lowe, 2006). An osseous crown-lengthening procedure is required to enhance the appearance of a patient’s smile, prevent violation of the biologic width, and/or provide sufficient tooth structure for the placement of dental restorations. The erbium lasers allow the clinician to offer the patient a minimally invasive alternative to conventional treatment, which is known to have many adverse side effects. Hemostasis, stable postoperative margins and less collateral tissue damage are just some of the benefits of use of lasers. Above all, patients can see results of our work immediately, which is highly appreciated (Lowe, 2006).

Lasers in Removable Prosthodontics

The success of removable complete and partial dentures mainly depends on the preoperative evaluation of the supporting
hard and soft tissue structures and their proper preparation. Lasers can be applied in many preprosthetic surgeries. Stability, retention, function, and aesthetics of removable prostheses may be enhanced by proper laser manipulation of the soft tissues and underlying osseous structure.

1. Tuberosity reduction
2. Torus reduction
3. Soft tissue modification
4. Treatment of epulis fissuratum
5. Treatment of denture stomatitis
6. Residual ridge modification
7. Laser application in dental laboratory, such as laser welding of cast metal denture components, laser scanning of prepared cast for CAD-CAM fabrication (Punia et al., 2012).

Discussion

To date, lasers are offering revolutionary advantages in clinical applications for general dentists in the diagnosis and treatment of patients in everyday practice. These advantages over conventional instruments include: a completely bloodless surgical area/hemostasis (very important in the treatment of highly vascularized lesions and in the management of patients with infectious diseases), sterility, the absence of sutures with good healing by secondary intention, minimal postoperative patient discomfort (pain and swelling), less mental stress and anxiety (related to noise, heat and vibration of high speed rotary instrumentation). Even though majority of studies show the advantages of lasers, some drawbacks and unsolved problems are still present, such as the cost of the laser device and the large dimensions of the systems due to the complexity of the device. Usually, dental office requires lasers of different wavelengths to be employed for different dental procedures, since no single laser wavelength is considered capable to optimally treat all dental diseases. Also, if used improperly, laser can pose some risks related to its use. In order to successfully avoid risks, laser practitioners should be highly familiar with the characteristics of the laser wavelengths and its mode of employment, to receive the proper training to use lasers technology safely and effectively, in order to obtain the optimal results. The oral cavity is very complex anatomical area; therefore any improper use of laser can cause damage to the very important structures, which are surrounding targeted place.

Conclusion

Even though a considerable body of evidence has proven lasers as safe and effective treatment modalities, no single laser wavelength is capable to completely replace conventional mechanical instruments with improved clinical results, or to produce results that are not possible with current methods. Further, available literature does not give any strong evidence-based superiority of lasers upon conventional methods. Therefore, more comparative clinical studies should be performed to find the optimal power settings for safe irradiation, without any harmful effects on the surrounding tissue in order to clarify the benefits of lasers upon conventional therapy. Only then, we will be able to support lasers' widespread use in everyday dental practice.

References


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<table>
<thead>
<tr>
<th>Laser type</th>
<th>Wavelength (nm)</th>
<th>Physical construction of laser</th>
<th>Mode of wavelength emission</th>
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<tr>
<td>Argon (Ar)</td>
<td>488, 515</td>
<td>gas</td>
<td>Continuous wave</td>
</tr>
<tr>
<td>Diode</td>
<td>635, 670, 819-980</td>
<td>semiconductor</td>
<td>Continuous wave</td>
</tr>
<tr>
<td>Carbon dioxide (CO2)</td>
<td>10, 600</td>
<td>gas</td>
<td>Continuous wave</td>
</tr>
<tr>
<td>Neodymium:yttrium aluminum garnet (Nd:YAG)</td>
<td>1.064</td>
<td>solid-state</td>
<td>Free-running pulse</td>
</tr>
<tr>
<td>Holmium:yttrium aluminum garnet (Ho:YAG)</td>
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<td>solid-state</td>
<td>Free-running pulse</td>
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<tr>
<td>Erbium:yttrium aluminum garnet (Er:YAG)</td>
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<td>solid-state</td>
<td>Free-running pulse</td>
</tr>
<tr>
<td>Helium-Neon (He-Ne)</td>
<td>633</td>
<td>gas</td>
<td>Continuous wave</td>
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<tr>
<td>Erbium, chromium:yttrium scandium gallium garnet (Er:Cr:YSGG)</td>
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<tr>
<td>Potassium titanyl phosphate (KTP)</td>
<td>532</td>
<td>solid-state</td>
<td>Free-running pulse</td>
</tr>
</tbody>
</table>

Table 1. Common laser types used in dentistry


Histopathological profile of Oral and Maxillofacial lesions in University of Dental Medicine, Yangon: A five year study

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Abstract

Oral and Maxillofacial Pathology is integral for the proper diagnosis and rational treatment of the diseases of oral and maxillofacial region. In addition to daily diagnostic service, oral and maxillofacial pathological team actively participates in many research projects in an effort to further understanding of diseases. A retrospective study on analysis of biopsy specimens submitted by various departments from University of Dental Medicine (UDM) and General Hospitals to Department of Oral Medicine, UDM, Yangon from 2008 to 2012 September was conducted. The data regarding age, sex, location of the lesion, biopsy types and histopathological diagnosis were recorded and evaluated. Among the 1235 patients studied, average age 44.44 (± 18.47) years was noted along with male to female ratio nearly 1:1. Squamous cell carcinoma is found to be the commonest diagnosis among all the malignancies, with 277 cases (82.7%). Three cases of metastatic carcinoma were included in other malignancies of oral and maxillofacial region. Oral squamous cell carcinoma is frequently preceded by clinically visible oral premalignancies. Therefore, the awareness of dental professionals in early detection of oral cancer and improving the public knowledge about deleterious oral habits is of utmost importance.

Introduction

An accurate diagnosis is the vital need for proper management of a patient and an essential component of the patient’s comprehensive dental care and the foundation of high-quality dentistry (Zhang et al., 2008). It is based upon a carefully-elicited history and a detail clinical examination. While the diagnosis of some oral lesions can be made on the basis of the history and/or clinical findings, for others, the definitive diagnosis requires the aid of diagnostic tools in addition to clinically relevant data (Santarelli and Muzio, 2012). Biopsy and histopathological examinations are important complementary diagnostic tools in determining management and prognosis of suspicious oral lesions (Mendez et al., 2012).

Collecting the data on biopsied lesions can provide the base-line information about the degree of occurrence as well as their associated demographic characteristics. This study has been conducted with the aim to analyze the frequency of oral and maxillofacial lesions in biopsy specimens submitted to Oral Pathology Laboratory in University of Dental Medicine, Yangon over a five year period.

Material and Methods

In this retrospective and descriptive study, biopsy specimens sent to Oral Pathological Laboratory of University of Dental Medicine, Yangon from 2009 to 2012, September were analysed. The biopsy request forms were studied along with the specimens and demographic features such as age, sex, site of involvement, source of referral and histopathological diagnosis were recorded. All the obtained biopsy specimens were stained by routine Haematoxylin and Eosin and analyzed under light microscope.
Results and Discussion

Table (1) Age and sex distribution of patients

<table>
<thead>
<tr>
<th>No</th>
<th>Age Range</th>
<th>Sex</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>1</td>
<td>&lt; 20 years</td>
<td>66</td>
<td>74</td>
</tr>
<tr>
<td>2</td>
<td>21-40 years</td>
<td>182</td>
<td>192</td>
</tr>
<tr>
<td>3</td>
<td>41-60 years</td>
<td>263</td>
<td>215</td>
</tr>
<tr>
<td>4</td>
<td>61-80 years</td>
<td>93</td>
<td>136</td>
</tr>
<tr>
<td>5</td>
<td>&gt; 80 years</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>611</td>
<td>624</td>
</tr>
</tbody>
</table>

M:F = 1:1

A total of 1235 biopsy specimens sent to Oral Pathological Laboratory of University of Dental Medicine, Yangon were analyzed. In concern with the sex distribution, male: female ratio was found to be nearly 1:1. Most of the cases were aged between 41 to 60 years accounting for 38.7% (Table 1). More than 75% of the biopsy specimens were sent by Department of Oral and Maxillofacial Surgery, University of Dental Medicine, Yangon. The rest came from Department of Oral Medicine, Department of Periodontology, Department of Paedodontics and also from General Hospitals and General Practitioners.

Table (2) Distribution of histopathological diagnoses

<table>
<thead>
<tr>
<th>No.</th>
<th>Type of histopathological diagnosis</th>
<th>Sex</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Male</td>
<td>Female</td>
</tr>
<tr>
<td>1</td>
<td>Benign soft tissue lesions</td>
<td>186</td>
<td>269</td>
</tr>
<tr>
<td>2</td>
<td>Malignancies</td>
<td>212</td>
<td>123</td>
</tr>
<tr>
<td>3</td>
<td>Oral potentially malignant disorders</td>
<td>79</td>
<td>52</td>
</tr>
<tr>
<td>4</td>
<td>Odontogenic cysts</td>
<td>55</td>
<td>69</td>
</tr>
<tr>
<td>5</td>
<td>Odontogenic tumours</td>
<td>35</td>
<td>47</td>
</tr>
<tr>
<td>6</td>
<td>Salivary gland diseases</td>
<td>30</td>
<td>42</td>
</tr>
<tr>
<td>7</td>
<td>Bone diseases</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>8</td>
<td>Non-odontogenic cysts</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>611</td>
<td>624</td>
</tr>
</tbody>
</table>

Benign soft tissue lesions were the most common diagnosis (36.9%) among histopathological diagnoses, followed by malignant cases (27.1%) and oral potentially malignant disorders (10.6%) respectively (Table 2). Some potentially malignant disorders can be usually diagnosed by history and clinical examination, without confirmation by histopathologic examination. Moreover, the fact also pointed out that the malignancies were usually diagnosed only at frank malignancy stage rather than at the premalignancy stage, Therefore, the need to strengthen active efforts not only on oral cancer screening to get early detection but also to promote health education program for public awareness.
Table (3) Distribution of malignant diseases

<table>
<thead>
<tr>
<th>No.</th>
<th>Type of malignancy</th>
<th>Sex</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M</td>
<td>F</td>
</tr>
<tr>
<td>1</td>
<td>Oral squamous cell carcinoma</td>
<td>179</td>
<td>98</td>
</tr>
<tr>
<td>2</td>
<td>Verrucous carcinoma</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>Malignant odontogenic tumour</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Metastatic carcinoma to jaw</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Other malignancies</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>212</td>
<td>123</td>
</tr>
</tbody>
</table>

(P < 0.001)

Oral squamous cell carcinoma was the most common type of malignancy (82.7%) in this study (Table 3). It was more prevalent in males than in females (P<0.001). All the cases had related with betel quid chewing habits and males were more likely to display oral habits such as betel quid chewing, smoking and alcohol drinking than females in Myanmar population.

Three cases of metastatic carcinoma to jaw from other areas such as breast and lung were found in this study (Table 3). It emphasized the need to consider the differential diagnosis of oral malignancies, importance of histopathological findings and the awareness of dental practitioners about the possibility of metastatic carcinoma.

Table (4) Site distribution of oral squamous cell carcinoma

<table>
<thead>
<tr>
<th>No.</th>
<th>Site of involvement of oral squamous cell carcinoma</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Buccal mucosa</td>
<td>97</td>
<td>35.0%</td>
</tr>
<tr>
<td>2</td>
<td>Alveolus (gingiva)</td>
<td>77</td>
<td>27.9%</td>
</tr>
<tr>
<td>3</td>
<td>Tongue</td>
<td>54</td>
<td>19.5%</td>
</tr>
<tr>
<td>4</td>
<td>Floor of the mouth</td>
<td>27</td>
<td>9.8%</td>
</tr>
<tr>
<td>5</td>
<td>Vestibule</td>
<td>7</td>
<td>2.6%</td>
</tr>
<tr>
<td>6</td>
<td>Palate</td>
<td>5</td>
<td>1.8%</td>
</tr>
<tr>
<td>7</td>
<td>Others</td>
<td>9</td>
<td>3.4%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>277</td>
<td>100%</td>
</tr>
</tbody>
</table>

(P < 0.001)

According to the various studies, tongue is the most common intraoral site for oral squamous cell carcinoma (Neville and Day, 2002). In this study, buccal mucosa was found to be the commonest site (35.0%) followed by alveolus (27.9%), and tongue (19.5%) (Table 4). High occurrence in buccal mucosa might be due to most of the patients were accustomed with holding betel quid and betel quid substitutes in the buccal pouch.

**Conclusion**

As histopathologic examination is integral for the definitive diagnosis, all the abnormal tissues removed from oral cavity should be submitted promptly for microscopic evaluation and analysis. Oral squamous cell carcinoma was the most prevalent among overall malignancies, highlighted the importance of awareness of dental professionals in early detection of oral cancer and to improve public knowledge about deleterious tobacco habits. Furthermore, immunohistochemical studies and molecular studies should also need, not only to confirm and differentiate the different types of tumours but also for treatment modifications and to analyze the treatment outcome.
References


Original Article

Non surgical Interventions for the Management of Oral Submucous Fibrosis

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Department of Oral Medicine, University of Dental Medicine, Yangon

Abstract

The oral submucous fibrosis (OSMF) is a chronic disease and a well-recognized potentially malignant condition of the oral cavity associated with juxta-epithelial inflammatory reaction followed by fibroelastic change of the lamina propria, with epithelial atrophy leading to stiffness of the oral mucosa and causing trismus and inability to eat. Untreated and neglected cases of OSMF might end up as invasive squamous cell carcinoma.

Free radicals have more recently emerged as mediators of other phenotypic and genotypic changes that lead from mutation to neoplasia. The role of free radicals in the various oxidation processes in the body has lead to the identification of antioxidants in inhibiting and reversing the disease process. Lycopene is a safe antioxidant of utmost importance. Lycopene is a bright red carotene and carotenoid pigment and phytochemical found in tomatoes and other red fruits and vegetables, such as red carrots, watermelons and papayas.

Total 82 patients with oral submucous fibrosis were treated in University of Dental Medicine (Yangon) from 2010 to 2012. Different non surgical interventions by using of lycopene (Tomatec®_FAME pharmaceuticals) alone, combination with intra-lesional steroid injection in management of OSMF will be discussed along with reported cases.

Introduction

Oral submucous fibrosis (OSMF) is a chronic disease and a well-recognized potentially malignant condition of the oral cavity characterized by inflammation and a progressive fibrosis of the lamina propria and deeper connective tissues with epithelial atrophy followed by stiffening of oral mucosa resulting in difficulty in opening the mouth (Ali et al.,2012). A multifactorial model for the pathogenesis of OSMF such as iron and nutritional deficiencies, consumption of chewing areca nut, excessive use of chilies and spices, chronic candidiasis, tobacco, lime, betel quid, genetic abnormalities, Herpes simplex virus (HSV), Human papilloma virus (HPV), autoimmunity etc. have been postulated and are known to have either have direct effect in causing OSMF or an indirect effect by mediating the immune system which is compromised in OSMF (Sudarshan et al., 2012).

A malignant transformation rate of 11.7% was reported with OSF which was seen predominantly in males (87%) (Pundir et al., 2010). Chewing of betel quid (areca catechu, lime and tobacco) as well as other areca nut containing products (e.g. pan masala and gutkha) for mouth freshening and the mild euphoric effect is common practice (Fig. 1A-1D). Pan masala and gutkha (shikhar) are dry products and can assume that the reactive oxygen species (ROS) concentration will increase in the oral cavity of chewers result in the formation of...
high levels of ROS close to the buccal mucosa. Reactive oxygen species (ROS), implicated in multistage carcinogenesis. Lycopene is able to protect against oxidative stress (van Breemen and Pajkovic, 2008).

Materials and Method

Total 81 patients with oral submucous fibrosis were treated in University of Dental Medicine (Yangon) from 2010 to 2012. The patient was advised to discontinue the use of areca nut in all preparations. Mouth opening was assessed by measuring from the mesioincisal edge of the upper left central incisor tooth to the mesioincisal edge of the lower left central incisor tooth. The measurement was made using a geometric divider and scale and was recorded in millimeters (Fig. 2). Lycopene used in this study was Tomatec® 10 mg) manufactured by Fame Pharmaceuticals.
We prescribed Lycopene (Tomatec®, Fame Pharmaceutical) 10 mg BD and Nature-C® (Fame Pharmaceutical) 500 mg BD (Fig 3A and 3B), topical application of antifungal along with mouth opening exercise without intralesional steroid injection for early stage and with intralesional steroid injection (Fig. 5) for advanced stage of OSMF (Fig. 4A and 4B).

**Results and Discussion**

Out of 81 OSMF, 83% (67) were males and 17% (14) were females, with a male to female ratio being 4.78:1 (Fig. 6).

Patient age ranges from 17-85 years, most patients are aged 21-40 years with the chewing habit of betel quid 50 quids per day and betel quid substitutes. Male predominance in our study can be due to easy accessibility for males to use areca nut and its products more frequently than females and changing lifestyles of the youngsters. Among 81 patients, only 6 patients presented with early OSMF, 13 patients who completed treatment included only one early OSMF, 60 were dropped out and 7 are still taking treatment.
Dropped out cases may be due to socioeconomic problems, difficulty in transportation, relief of major symptoms or may be noncompliance. All patients gave history of areca nut chewing alone, as a betel quid including tobacco such as 92, Queen, signal etc. or in a commercial preparation such as gutkha(shikhar ) and pan masala. The duration of habits was ranging from 6 months to 15 years. The frequency of chews per day varied between 5 and 30 per day. The average improvement in mouth opening (only Lycopene (Tomatec®, Fame Pharmaceutical) 10 mg BD, Nature-C® (Fame Pharmaceutical) 500 mg BD, topical application of antifungal along with mouth opening exercise in early OSMF, increased by 1.4 cm and a complete relief from burning sensation and stiffness within 2 weeks of instituting therapy. After 3 months, marked improvement in mouth opening were recorded when compared with initial mouth opening in early stage of OSMF cases (Fig. 8A and 8B).

![Fig. 8A Before treatment](image1)  ![Fig. 8B After 3 months](image2)

The advanced stage of OSMF patients (intraleisional kenacort (10 mg/ml) injection once a week for 3 months along with Tomatec® (Fame Pharmaceutical) 10 mg BD and Nature-C® (Fame Pharmaceutical) 500 mg BD, topical application of antifungal plus mouth opening exercise) showed an average improvement of 2.4 cm (Fig. 9A-9B). There were no associated side effects with the use of Lycopene.

Lycopene either singly or in combination with intraleisional steroids is, efficacious in improving the mouth opening and in reducing associated symptoms. The combination of lycopene and intraleisional steroids conferred greater benefits in mouth opening, the use of only lycopene demonstrated improvement in mouth opening sooner. This effect was seen by the third week of treatment. The better results may be attributed to the synergistic action of lycopene with steroids, both of which have been known to modulate the inflammatory response. Lycopene was seen to be efficacious as a safe, reliable drug.

![Fig. 9A. Before treatment](image3)  ![Fig. 9B After 3 months](image4)
Conclusion

The use of commercially available areca nut and tobacco byproducts (potent carcinogenic mixtures) are addictive and enhance the early appearance of OSMF, especially in young users who could be more susceptible to the disease. Lycopene has several potent anti-carcinogenic and antioxidant properties and has been found to inhibit human fibroblast activity in vitro suggesting its possible role in the management of oral submucous fibrosis. Tomatec® (Fame Pharmaceutical) (Lycopene) 10mg was easily available in Myanmar which is efficacious as a safe, reliable drug in the management of oral submucous fibrosis cases who took regular treatment and follow up for minimum one year. It is highly important to make the people aware of the possible hazardous effects of chewing habits and to prevent further progression of OSMF to malignancy. An emphasis on education aimed at reducing or elimination the use of these products as well as urgent action needs to be taken to permanently ban pan masala and gutkha(shikhar) together with the other well-established oral cancer-causing tobacco products.

References


A Study on the Effectiveness of Different Cleansing Methods for the Removable Dentures

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3. Department of Prosthodontics, University of Dental Medicine, Mandalay.

Abstract

Denture biofilm and poor denture hygiene are associated with many oral and systemic diseases in both completely and partially edentulous patients. Adequate hygiene prevents formation of biofilm and associated problems. The aim of this study was to compare the effectiveness of different cleansing methods for the reduction of denture biofilm in the removable dentures. Thirty two (seventeen complete and fifteen partial) acrylic removable dentures were constructed for subjects according to their needs. One week after delivery of dentures, baseline biofilm quantification was performed and then dentures were cleaned by using following methods in random manner, one week for each method: (1) rinsing with water (control) (2) brushing with liquid soap and water (3) soaking in 0.5% sodium hypochlorite solution (4) combination of brushing and soaking. Percentage of biofilm coverage area was assessed by disclosing with 1% neutral red solution and quantified by means of digital photos taken from four views and calculating biofilm coverage area by using Image J software. Significant differences in percentage of biofilm coverage area in both complete and partial dentures were observed between methods (repeated measures ANOVA, p < 0.05). Brushing showed lower biofilm coverage percent than control but soaking in 0.5% sodium hypochlorite solution was more effective than brushing. Among evaluated cleansing methods, combination of chemical and mechanical methods was the most effective method in reduction of biofilm for the removable dentures.

INTRODUCTION

Although there is increasing trend in the size and life span of the elderly population, generally the life span of their teeth does not appear to be increasing. As a result, the period for wearing removable dentures is increasing (Hayakawa, 1999). Increasing use of denture has led to a concomitant increase in the incident of denture related health problems.

In comparison with the dentate individual, the oral environment of the denture wearer presents additional hard, non-shedding areas and new environments (tissue-fitting surfaces) to
support the growth of microorganisms and the development of biofilm (Coulthwaite & Verran, 2007).

Biofilm, stain, and calculus form on the surfaces of dentures in a similar manner to natural teeth (Neill, 1968). Composition of microbial flora of denture biofilm is same as dental biofilm with the exception of increased number of Candida species (Nikawa et al., 1998). These yeasts are present in the saliva of a majority of denture wearers and show an affinity for adherence to methacrylate resin (Shay et al., 1997).

Acrylic resin bases of both partial and complete removable dentures attract stain and odor-producing organic and inorganic deposits (Augsburger & Elahi, 1982). Calculus deposit on dentures consists essentially of an organic and inorganic portion. The organic portion comprises of 15% - 35% and is basically glycoprotein which is responsible for binding microorganisms and deposit to denture (Love & Minon, 1967). Biofilm accumulates preferentially at stagnant sites which offer protection from salivary flow and mechanical removal forces in the mouth, and the denture provides many such sites (Marsh, 2004).

Rough or surface irregularities also favor the adherence of microorganism and debris. Surface irregularities provide an increase in surface area and an expansion in the number of niches which will not be readily cleansed by actions of the tongue or other oro-facial musculature. This is a particular concern in the case of oral appliances fabricated out of methacrylate.

Denture biofilm and poor denture hygiene is associated with stomatitis (Candida infection). It may also serve as a reservoir of potentially infectious pathogens and may contribute to oral malodour and to caries and periodontitis in people who have remaining natural teeth (Coulthwaite & Verran, 2007).

Adequate hygiene prevents the formation of biofilm, diminishes accumulation of organic material, bacteria and fungal proliferation (the cause of halitosis), pigmentation of the acrylic resin, calculus formation, denture stomatitis and potentially pleura-pneumonic or gastro-intestinal infection (Antonio et al., 2007).

Therefore materials and methods for quantification of denture biofilm have become a matter of interest. As in natural teeth, efficient hygiene control in dentures can be obtained by correct use of materials and methods available for denture cleansing. Dentures can be cleaned mechanically, chemically, or through a combination of both.

Mechanical methods are comprised of brushing (associated with water, soap, dentifrice or abrasives) and use of ultrasonic device. Chemical methods are classified according to their composition and mechanism of action, i.e., hypochlorites, peroxides, enzymes, acids, crude drugs and mouth washes (oral rinses) for dentures.

Previous data have shown that brushing with dentifrice is one of the most common methods of denture hygiene (Nikawa et al., 1999). Brushing is a simple, inexpensive and effective method for the removal of denture biofilm. However, patients with restricted hand movement may experience difficulties with this method. The abrasive action could also result in the wear of the denture base and relining materials (Mendonca et al., 2006).

Chemical methods for cleaning dentures mainly include soaking in a household or commercial solution. These solutions are simple to employ and can easily reach undercuts of the denture base. They also leave roughness of the acrylic resin's surface unchanged, and therefore possibly less susceptible to biofilm accumulation. However, some agents employed in denture cleaning are relatively expensive, and are known to damage acrylic resin and metal alloys (Jagger & Harrison, 1995).

This study was aimed to compare the effectiveness of different cleansing methods for the reduction of denture biofilm in the removable dentures.

**Materials and Methods**

A randomized Controlled Clinical trial was carried out with 32 edentulous or partially edentulous patients, both genders, 35 years and above attending the Department of Prosthodontics, University of Dental Medicine, Yangon, demanding prosthetic treatment. Patients with motor deficiency or restricted hand movement who may experience difficulties with cleansing methods, patients who had taken any antibiotics during previous 2 weeks, patients taking xerostomic drugs, patients with bad oral habits like betel quid chewing, smoking and un co-operative patient who did not want to perform cleansing methods were excluded.

Each patient received detail explanation about the procedure before he/she signed written informed consent. Removable dentures were constructed for each patient according to their needs. Conventional complete and partial dentures were fabricated with heat polymerized acrylic resin and acrylic teeth according to the prosthodontic principles. All the clinical and laboratory work for all cases were performed by same dentist and
same dental technician.

Biofilm quantification was done by the following procedures. The dentures were removed from the mouth, rinsed with running water for 5 sec and air-dried for 10 sec, then disclosed with disclosing agent (1% neutral red) for 1 minute. After that, dentures were rinsed and dry again for taking digital images with digital camera (Sony DSC-W270 with wide-angle lens 28mm, optical steady shot and 12.1 MEGA PIXELS). Images were taken with standardized film-object distance for defined areas: the left and right buccal polished surfaces (including all denture teeth visible on each side), the palatal or lingual polished surface, and the impression surface. After that, the dentures were cleaned thoroughly using specific denture brush and liquid soap in order to perform complete biofilm removal and then returned to the patients. The images were analyzed using the Image J software. The percentage of biofilm coverage area was calculated as the ratio between disclosed areas (red color) and the total surface area of the denture multiplied by 100.

Baseline percentage of biofilm coverage area was recorded at one week after denture delivery. After baseline biofilm quantification, cleansing methods were introduced. The patients received verbal information and practical demonstration of hygiene methods and they were instructed to clean their dentures according to the following methods.

1. **Control**
   Rinsing with water after meals (breakfast, lunch and dinner) followed by immersing in water over night.

2. **Chemical**
   Soaking in 0.5% sodium hypochlorite solution for 10 minutes then rinsing with water before insertion of denture into mouth after meal (breakfast, lunch and dinner) followed by immersing in water over night.

3. **Mechanical**
   Brushing three times a day with liquid soap and water after meals (breakfast, lunch and dinner) followed by immersing in water over night.

4. **Combination**
   Combination of mechanical and chemical methods i.e. first, brushing with liquid soap and water followed by soaking in 0.5% sodium hypochlorite solution for 10 minutes, then rinsing with water before insertion of denture into mouth after meal (breakfast, lunch and dinner) followed by immersing in water over night. All patients were asked to clean their dentures by using each of the four methods for one week each followed by biofilm quantification. The methods were assigned in random sequence.

Data analysis

Data were analyzed by using Statistical Package for Social Science (SPSS) statistical software (version-16.5). Analysis of Variance (ANOVA) was used for repeated measures on each factor.

Results

Percentage of biofilm covering area on complete dentures with different cleansing methods

Figure 1 showed the results of percentage of biofilm coverage area in complete dentures. There were significant differences among various cleansing methods (repeated measures ANOVA, F(1,16)=46.464, p<0.001). Bonferroni’s multiple comparisons test revealed no significant difference in biofilm coverage area between control (rinsing with water) and baseline (p=0.939). Chemical method showed significantly less biofilm than control (p<0.001) and mechanical method (p=0.026). The percentage of biofilm covering area was the lowest by using combination of mechanical and chemical method when compared with all other methods (p<0.05).
Figure 1. Percentage of biofilm coverage area after each cleaning method for complete dentures.

![Complete dentures](image1)

Error bars: mean + 1 SD. Values are shown as mean and SD (n=17).

* p<0.05, significantly less biofilm % than all other groups

** p<0.05, significantly less biofilm % than baseline, control and mechanical but higher than combination

*** p<0.05, significantly less biofilm % than baseline and control but higher than chemical and combination

Figure 2. Percentage of biofilm coverage area after each cleaning method for partial dentures.

![Partial dentures](image2)

Error bars: mean + 1 SD. Values are shown as mean and SD (n=15).

* p<0.05, significantly less biofilm % than baseline, control and mechanical

** p<0.05, significantly less biofilm % than baseline and control but higher than chemical and combination

Analyzing by repeated measures (f(1,14) = 96.727, p<0.001), there was statistically significant difference among various hygiene methods. Figure 2 illustrates the multiple comparisons test (Bonferroni) results for different cleansing methods. There was no significant difference between control and baseline biofilm covering area (p>0.05). Significant difference was observed with mechanical method compared with all other methods (p<0.05). In this method, there was less biofilm covering area than control but more area of biofilm was found in comparison with the chemical and combination. Significant difference was not found between chemical and combination.
of mechanical and chemical methods (p=0.074). Significantly less percentage of biofilm covering area was observed with these two methods when compared with other methods (p<0.01).

**Biofilm deposition in different area**

Concerning with base line biofilm quantification, almost all areas of impression surfaces were covered with biofilm. On the polished surface, highest amount of biofilm was found between the pits and grooves of the occlusal surfaces and embrasures of both maxillary and mandibular complete dentures, and the posterior border of the maxillary complete dentures. Concerning with control, biofilm was left at the undercuts and surface irregularities of vestibular incline and palatal/lingual incline of alveolar ridge, maxillary tuberosity area and posterior border on the impression surface. On the polished surface, the same areas of biofilm retention but lesser amount of biofilm coverage were observed with control and mechanical method. Very little amount of biofilm was found at the surface irregularities of alveolar ridge and the pits and grooves the occlusal surfaces following chemical method. Almost total reduction of biofilm was observed following combination of mechanical and chemical methods (Figure 3).

On baseline biofilm assessment for removable partial dentures, the inner surface of clasps, areas adjacent to the acrylic collapses, areas of the impression surface adjacent to abutment tooth, embrasures and occlusal surfaces of acrylic teeth, and lingual flanges showed the highest amount of biofilm retention (Figure 4).

Figure 3. Disclosed surfaces of complete dentures following different hygiene methods. Arrows denotes the biofilm covering areas.
Despite the same areas of biofilm retention were observed with baseline, control and mechanical methods, different (i.e. lesser) amount of biofilm coverage was found with control and mechanical method. All biofilm covering area was almost cleaned completely on polished surface following chemical and combination of mechanical and chemical methods (Figure 3&4).

**Discussion**

In this study, we evaluated the effectiveness of different cleansing methods for reduction of denture biofilm from all surfaces of acrylic removable dentures.

**Baseline biofilm deposition**

The high standard deviation of the baseline biofilm amount in this study reveals that biofilm adherence is variable among denture wearers. The amount of biofilm adherence may depend on the denture design as well as duration of denture wearing time as illustrated by Addy and Bates (1979).

Concerning with specific areas more subjected to biofilm adherence, impression surfaces showed more biofilm coverage than polished surfaces in both complete and partial dentures although the differences did not reach statistical significance.

The most biofilm retentive areas of the impression surface are the area of undercuts and surface irregularities, vestibular incline and lingual incline of alveolar ridge, maxillary tuberosity and post-dam areas of complete dentures. In the polished surface, highest amount of biofilm were found between the pits and grooves of the occlusal surface and embrasure area. Amount of biofilm were lower for some areas with relatively smooth and flat configuration such as buccal flanges and central palatal area of both impression surfaces and polished surfaces. These findings corresponded with Kulak et.al (1997) who reported that rough or surface irregularities favored the adherence of microorganism and debris. Surface irregularities provide an increase in surface area and an expansion in the number of niches which will not be readily cleansed by actions of the tongue or other oro-facial musculature.

In the cases of partial dentures, highest amount of biofilm were found at the inner surface of clasps, areas adjacent to the acrylic collapses and rugae irregularities and areas of the impression surface adjacent to abutment tooth. This finding correlates with those of Addy and Bates (1979) demonstrating that significant increase in biofilm occurred on the lingual aspect of lower anterior teeth covered by lingual plate of the partial denture. On the polished surface, interdental areas and occlusal surfaces of acrylic teeth and lingual flanges showed the highest amount of biofilm. This result matches with Wagner (1973) stating that clasps, rests, inaccessible characteristic rugae irregularities of the partial denture are difficult to clean.

These data demonstrated that biofilm accumulates preferentially at stagnant sites which offer protection from salivary flow and mechanical removal forces in the mouth. This is in agreement with Marsh (2004) who stated that the denture...
provides many such sites.

The adherence of microorganisms to removable denture and the subsequent biofilm formation on the surfaces are contributory factors to biofilm-related oral and systemic diseases. This has long been recognized as an important health concern. Fungal growth not only leads to tissue irritation and denture stomatitis (Zarb, 1985) but is also responsible for caries, root caries and periodontal diseases (Nikawa et al., 1998). Denture biofilm also has been associated with malodor, aspiration pneumonia, infective endocarditis and other systemic conditions especially in elderly and dependent populations (Coulthwaite & Verran, 2007). Therefore reduction of denture biofilm become of prime importance.

**Effectiveness of evaluated denture hygiene measures**

Among evaluated denture hygiene measures, rinsing with water (control) was shown to be the least efficacious for biofilm reduction as previously expected. Percentage of biofilm coverage area after rinsing with water was not significantly different with baseline biofilm coverage percent (p>0.05). This demonstrates that denture biofilm, like dental biofilm, tenaciously attaches to the surface of denture so that rinsing with water only is not sufficient for its removal.

Among proposed methods for reduction of denture biofilm, brushing with any common toothpaste is the most widely used. However care must be taken due to the risk of abrasion of the acrylic resin with resultant loss of luster, biofilm accumulation and reduction of the pigmentation of the prosthetic device. Brushing with non abrasive paste specific for dentures proved to be effective (Paranhos et al., 2000). But those products are not always available in Myanmar market. Soap, as an auxiliary hygiene agent is a customarily found abrasive-free product in our country. Liquid soap is used for its non-abrasiveness (Gofou et al., 2001), availability and low cost which is affordable to denture wearers. In addition, liquid form enabled easy application to the toothbrush.

In spite of the need for specific denture brushes and of the proven effectiveness of such products (Silva & Paranhos, 2006; Fernandes et al., 2007), a toothbrush with soft bristles (Oral B soft toothbrush) was chosen with the aim of preventing wear of the denture base or artificial teeth. In addition, it has a rounded head design which allows easier and better adaptation to the denture's internal surface with this configuration. It is also a readily available product. A limited number of specific denture hygiene products in the local market and high cost may also be one of the reasons for widely use of conventional brushes.

In our study, brushing with liquid soap (mechanical method) has revealed better cleansing effects than rinsing with water alone. However, certain amount of biofilm was left in areas where toothbrush has not accessible such as characteristic rugae irregularities, undercut areas of denture base and interdental areas of both complete and partial dentures and the surfaces of clasps and denture base facing the abutment teeth of partial dentures. Being conventional design, Oral B soft brush may be less accessible to those areas where specific denture brushes might work better. This outcome supports that of Wagner (1973) who explained ordinary brushes are seldom completely satisfactory for cleansing removable dentures. On the other hand, this may also be an indication that denture wearers might not give emphasis to these biofilm retentive areas during cleansing with brush.

For this reason, specific denture brushes for complete dentures and specially designed denture brushes such as spiral brushes and regular denture brushes for partial dentures might be necessary for better results. While these products have limited user-friendliness and scarcity in the domestic market, cleansing with chemical agents which can readily reach undercuts of the denture base should be considered.

Furthermore, effectiveness of mechanical cleansing method is dependent upon patient compliance and manual dexterity. For instance, a patient might clean the denture thoroughly and biofilm was left only at the undercuts of the denture base where toothbrush was inaccessible while the other might do imprecisely leaving much biofilm even on the polished surface.

Soaking in 0.5% sodium hypochloride (chemical method) is more efficacious than mechanical method in removing denture biofilm. Significant reduction in biofilm was found with this method in both complete and partial dentures (p<0.05). By soaking the whole denture in the solution, the solution can easily reach the undercuts of the denture base and inaccessible areas of the dentures. This result supports the studies (Chan et al., 1991; Kulak et al., 1997) reporting chemical approach for more effective denture hygiene measure when compared with brushing. In contrast, Tarbet et al. (1984) and Paranhos et al. (2007) reported brushing as a better approach. This discrepancy may be due to the differences in chemical agents used or differing laboratory
Hypochloride denture cleansers are fungicidal and are known to be effective by dissolving mucin and other organic substances (Kulak, 1997). Several studies have indicated sodium hypochloride as useful and inexpensive disinfectant for cleaning of dentures (Barnabe et al., 2004; Falah-Tafti et al., 2008).

In our pilot study, comparison of effectiveness of different chemical agents was performed using acrylic test discs and three common denture cleansing agents (0.5% sodium hypochloride, 4% chlorhexidine and 8% hydrogen peroxide). Sodium hypochloride was found to be the most effective one among tested chemical agents.

In the past, soaking dentures in sodium hypochloride was controversial because of its potential detrimental effects on the denture material. Rudd et al. (1984) tested the effect on the color stability and surface properties of acrylic denture base by soaking into water or full strength of Clorox (5.25% sodium hypochloride) for 15 hours. Two Board-certified prosthodontists were unable to determine any difference in color, surface detail or finish, and could not determine which half had been soaked in water or full-strength Chlorox for 15 hours.

Pavarina et al. (2003) investigated the effect of disinfectant solution on hardness of acrylic resin denture teeth. In their study, specimens were immersed in chemical disinfectants (4% chlorhexidine, 1% sodium hypochloride and sodium perborate) for 10 minutes and no significant effect on surface hardness of specimens was found after immersion in any of the solutions.

Additionally, Azevedo et al. (2006) studied effects of chemical agents on hardness and roughness of reline acrylic resins and concluded that the disinfectant solutions, 1% sodium hypochloride and 4% chlorhexidine gluconate caused no apparent damage on hardness or roughness of the materials after 7 days of immersion in both disinfectants. It is therefore unlikely that 10 minutes soak in 0.5% will affect the denture material.

Combination of chemical and mechanical methods was found to be the most effective method for denture biofilm reduction in the complete denture cases. This outcome supports several previous studies reporting the need for use of chemical method in addition to brushing for complete denture hygiene (Tarbet et al., 1984; Paranhos et al., 2007).

Concerning with the partial denture cases, chemical method alone and combination of mechanical and chemical methods were shown to be the most efficacious denture hygiene approaches. Although decreasing trend of biofilm was found with the combination of mechanical and chemical methods, the difference did not get in touch with statistically significant level when compared with chemical method alone (p>0.05). This is probably due to the fact that brushing with conventional tooth brush may not satisfactorily reduce the amount of biofilm in removable partial denture since accessibility of this brush to all areas of partial dentures might not be easy. On the other hand, chemical method has significantly removed accumulated biofilm so that addition of mechanical method seems to be of little difference with chemical method alone.

In the present study, only acrylic removable dentures were evaluated. The effectiveness of sodium hypochloride for biofilm removal on acrylic removable dentures was satisfactory. But its effectiveness on metallic dentures has not been assessed in the present study. Some studies did not recommend use of sodium hypochloride on metallic dentures by reason of its corrosive effects and effects on surface roughness on metals (MacGregor & Watt, 1985; Ural et al., 2011) while some study reported it uses with caution such as avoiding prolong soaking in solution (Jagger and Harrison, 1999). Therefore, further studies are needed on this matter.

Concerning with chemical agent, the present study included soaking dentures in 0.5% sodium hypochloride for 10 minutes since previous studies indicated this concentration and time duration are effective (Shay et al., 2000). However further studies to approach the outcome of different immersion times and different concentrations are necessary.

CONCLUSION

Within the limitation of this study, it can be concluded that:

1. The effect of biofilm reduction by 0.5% sodium hypochloride was more effective than brushing with liquid soap and water.
2. Brushing alone cannot satisfactorily reduce the amount of biofilm to a certain level for both acrylic complete and partial dentures. Use of chemical agent should be recommended in addition to brushing.
3. Among evaluated cleansing methods, combination of chemical and mechanical methods was the most effective method.
4. Even if both brushing and soaking with chemical agent is not able to perform, at least, soaking should be done to effectively remove the biofilm.

REFERENCE LIST


ABSTRACT

Residual ridge resorption is physiologically an inevitable consequence of tooth loss and denture wearing. The commonest problem of long term denture wearers is looseness or poor fitting of the dentures due to continuous alveolar resorption. Insufficient retention of prostheses may lead to poor masticatory efficiency and reduced patient satisfaction. In this study, the effectiveness of soft liner in 22 patients wearing poorly fitting complete dentures was determined and soft lined dentures were compared with new dentures in retention, maximal biting force and patient satisfaction. Retention of all study dentures was evaluated by Kapur’s method, the maximal biting force was measured by using Unipulse Digital Bite Force Indicator and the patient satisfaction was assessed by modified Smith’s method. The differences in retention scores of old dentures and soft lined dentures, and old dentures and new dentures, were statistically significant (p<0.05). Both soft lined and new dentures provided higher retention than old dentures. There was no statistically significant difference between retention scores of soft lined dentures and new dentures (p>0.05). The maximal biting force was significantly improved after soft lining the old denture and when the patient changing from old to new dentures (p<0.05). In terms of patient satisfaction scores of soft lined and new denture, there were no statistically significant differences found (p>0.05).

This study concluded that soft liner could provide good retention, improve masticatory efficiency and patient satisfaction in poorly fitting complete dentures. Although soft liner could not completely substitute standard new denture treatment, it might provide functionally satisfied dentures with only a single visit chairside application.

INTRODUCTION

Alveolar resorption is a continuous process though varying in degree (Atwood, 1971; Tallgren, 1972; Bergman, 1985; Zarb, 1997). The commonest complaints of patient who wear complete dentures are that the dentures are loose and that they cause pain (Watt, 1986). The comfort, efficiency, stability, retention and appearance of the dentures are all liable to become impaired with the long passage of time. Face, jaw and tissues change over the time passed, but denture, prosthesis does not. They cannot adapt to physical changes and patient may become less satisfied with their existing dentures. However, making a new prosthesis is time consuming, costly and the patient would try to get adaptation to new prosthesis again and again. Both clinicians and patients need to understand that adaptation to new prostheses is a long term process. On the other hand, some patients want to get more performance or a better status of their old prostheses rather than replacing with new one. This may be due to the economy, time and familiarity with their old dentures. Even
in some cases where prescribing a new denture, the old denture can be modified by soft lining it for the benefits of the patient. The patient can get well functioning dentures only in a single visit by soft lining. In this study, the effectiveness of using soft liner material in poorly fitting complete dentures was determined and compared with new dentures in terms of retention, maximal biting force and patient satisfaction.

MATERIALS AND METHODS

Twenty two upper and lower complete denture wearing patients attending the Department of Prosthodontics, University of Dental Medicine, Yangon during the study period of one year were selected according to the selection criteria. All procedures were performed with standard apparatus and equipment used in the department. Soft denture reline material (GC Co., Tokyo, Japan) for relining, Unipulse Digital Bite Force Indicator (F340A, NEC Sanei Instruments Ltd., Japan) for measuring biting force and pre-structured questionnaires for interviewing patient satisfaction were used. Type of study was experimental study, clinical trial and after checking and cleaning, data were analyzed with the application of the SPSS statistical software (version-13).

Each patient received detail explanation about the research procedure and signed in informed consent form. On the first visit of the patient, retention, maximal biting force and patient satisfaction of old denture were assessed. Retention of both maxillary and mandibular complete dentures were examined and scored according to Kapur’s method (1967). Poorer scores were taken between maxillary and mandibular complete dentures of each patient. Then, the maximal biting force was measured by using the bite force meter. Small 4 mm diameter pressure sensitive sensor was attached with bite force meter and this sensor can withstand up to 50 kilograms force (kgf). The bite force meter was set to record only the maximum force among the various exerting forces by the patient. Then the patient was requested to bite on the sensor with maximum effort at mandibular first molar area. The peak force value indicated on the force meter was recorded. The measurements were done three times for the specified tooth on both sides and highest measurement was recorded. After observation of old dentures, primary impression making was also done for new denture fabrication. The new complete dentures were fabricated according to standard methods used in the department. Next day on the second visit, soft lining material (Soft liner, GC Co., Tokyo, Japan) was applied on the fitting surface of poorly fitting old dentures and then retention and maximal biting force were measured and recorded as mentioned above. Then satisfaction of the patient was assessed by using questionnaire (modified Smith’s method). On the third visit, secondary impression making was done and jaw relation registration made on the fourth visit. Try-in stage of new denture was carried out on fifth visit. On the sixth visit, new dentures were delivered. Follow-up recall on the next day appointment for denture adjustments and three parameters were measured in the same manner. Long term use of soft lined old dentures or new dentures was the independent choice of the patients.

RESULTS

Table 1. Retention scores in old, soft lined and new dentures

<table>
<thead>
<tr>
<th></th>
<th>Good retention %</th>
<th>Moderate retention %</th>
<th>Minimum retention %</th>
<th>No retention %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old denture</td>
<td></td>
<td></td>
<td>1 (4.5%)</td>
<td>21 (95.5%)</td>
</tr>
<tr>
<td>Soft lined old denture</td>
<td>22 (100%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New denture</td>
<td>21 (95.5%)</td>
<td>1 (4.5%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 1. Soft denture reline material (GC Co., Tokyo, Japan) and Digital Bite Force Indicator (F 340A) attached with sensor.

Figure 2, 3, 4. Soft lining the old denture.
Table 2. Mean comparison of retention scores between soft lined and new dentures (Wilcoxon Signed Ranks Test)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Mean difference</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft lined dentures</td>
<td>3.0</td>
<td>0.00</td>
<td>-1.0</td>
<td>0.317@</td>
</tr>
<tr>
<td>New dentures</td>
<td>2.95</td>
<td>0.21</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

@ p>0.05 means no significant difference

Table 3. Maximal biting forces comparison in old, soft lined and new dentures

<table>
<thead>
<tr>
<th></th>
<th>Old denture</th>
<th>Soft Lined denture</th>
<th>New denture</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>22</td>
<td>22</td>
<td>22</td>
</tr>
<tr>
<td>Mean</td>
<td>5.05</td>
<td>6.71</td>
<td>7.31</td>
</tr>
<tr>
<td>Median</td>
<td>5.20</td>
<td>6.75</td>
<td>7.36</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>0.90</td>
<td>0.93</td>
<td>0.67</td>
</tr>
<tr>
<td>Minimum</td>
<td>3.71</td>
<td>5.20</td>
<td>6.30</td>
</tr>
<tr>
<td>Maximum</td>
<td>6.80</td>
<td>8.91</td>
<td>8.91</td>
</tr>
</tbody>
</table>

Table 4. Mean comparison of maximal biting forces between old and soft lined dentures (Wilcoxon Signed Ranks Test)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Mean difference</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old dentures</td>
<td>5.05</td>
<td>0.90</td>
<td>-4.107</td>
<td>&lt; 0.001*</td>
</tr>
<tr>
<td>Soft lined dentures</td>
<td>6.71</td>
<td>0.93</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p<0.05 means significant difference

Table 5. Mean comparison of maximal biting forces between soft lined and new dentures (Wilcoxon Signed Ranks Test)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Mean difference</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft lined dentures</td>
<td>6.71</td>
<td>0.93</td>
<td>-2.662</td>
<td>0.008*</td>
</tr>
<tr>
<td>New dentures</td>
<td>7.317</td>
<td>0.673</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p<0.05 means significant difference

Table 6. Total patient satisfaction scores in old, soft lined and new dentures

<table>
<thead>
<tr>
<th></th>
<th>Very satisfied (%)</th>
<th>Satisfied (%)</th>
<th>Not satisfied (%)</th>
<th>Total (no.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Old dentures</td>
<td>22 (100%)</td>
<td></td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>Soft lined dentures</td>
<td>21(95.45%)</td>
<td>1(4.55%)</td>
<td></td>
<td>22</td>
</tr>
<tr>
<td>New dentures</td>
<td>22 (100%)</td>
<td></td>
<td></td>
<td>22</td>
</tr>
</tbody>
</table>
Table 7. Comparison of patient satisfaction scores of soft lined and new denture (Wilcoxon Signed Ranks Test)

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Mean difference</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soft lined denture</td>
<td>2.95</td>
<td>0.213</td>
<td>-1.000</td>
<td>0.317@</td>
</tr>
<tr>
<td>New denture</td>
<td>3.00</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

@ p>0.05 means no significant difference

DISCUSSION

The common complaints of patients who wear complete dentures are that the dentures are loose and that they cause pain. Poor fitting dentures may spoil the health of the underlying mucosa and bone, reduced masticatory efficiency and patient satisfaction. There is a prompt, quick and effective solution using resilient soft denture liner.

Soft denture liners are widely used for denture wearers who complain of masticatory pain (Wright, 1984; Qudah, 1990; Hamada & Murata, 2001) and for poorly fitting old dentures to improve retention and stability (Garrett, 1996). By using soft liner, edentulous patients felt more comfortable in chewing (Schmidt & Smith, 1983) and improved masticatory ability (Kimoto et.al., 2007).

On denture retention

At the time of delivery, all 22 cases of soft lined dentures showed good retention while 21 out of 22 new denture cases received good retention. Only moderate retention was achieved in one patient with new denture. It may be due to old age of the patient (72 years) and unfavorable alveolar ridges. According to the classification of United Nations (1980) (cited in Kyu, 1998), this patient included in old old category and some difficulties may encounter in using new dentures at the time of delivery. It was found that soft lined old dentures provided good retention as compared with old dentures. The retention scores difference between old dentures and soft lined dentures, and old dentures and new dentures were statistically significant (p<0.05). It was also found that no statistically significant difference between retention scores of soft lined dentures and new dentures. Therefore, the results of this study proved the concept of Garrett (1996) that soft lining might improve retention and stability of poorly fitting old dentures. Soft liner (GC Co., Japan) could provide retention more than two months in some cases and in one case, it could maintain its functions up to one year except change in color. After the study, six out of 22 cases selected soft lined dentures as these patients had some adaptation problems with new dentures or less of willingness to try to get adaptation with new dentures.

On maximal biting forces

The mean biting force of old dentures was the lowest (5.05 kgf ) among other dentures while the highest force (7.31 kgf ) was granted by new dentures and (6.71 kgf ) by soft lined dentures. The differences between the old dentures and soft lined dentures and between old dentures and new dentures were statistically significant at p< 0.05. It confirmed the studies of Hamada (2002) and Hayakawa (2003) that the application of soft liners would lead to the most marked improvement in masticatory function.

In this study, it is speculated that insufficient retention of prosthesis is related to poor masticatory efficiency and patient satisfaction. By soft lining the poorly fitting old dentures, dentures would become more retentive and masticatory efficiency would be also improved. The results of this study revealed that the masticatory efficiency increased significantly when the patient’s poorly fitting dentures were relined with soft liner or replaced with new dentures. So, this study reinforced the study of Garrett (1996), who had shown that denture wearers perceived marked improvements in their chewing comfort, chewing ability, eating enjoyment after poorly fitting dentures were modified to make them fit with soft liner or replace with new dentures. But the result of this study showed that the new dentures provided higher biting forces compared to soft lined denture in both measurement times. It may be due to the difference in occlusal forms of artificial teeth and vertical relation of the maxilla and mandible. Soft liner may restore only limited vertical height and no effect on occlusal forms while new dentures restore exact original vertical height and anatomical occlusal forms. So it can be concluded that soft lining can provide increase masticatory efficiency (6.71 kgf) but not reach the level of maximal biting force provided by the new dentures (7.31 kgf).
Moreover, stability is primarily important factor for masticatory efficiency rather than retention. However, retention and stability are interrelated and inseparable. Nevertheless, stability depends on intimate contact of complete denture to underlying supporting tissues and occlusal harmony as well. So one should consider to achieve occlusal harmony for stability.

**On patient satisfaction**

In assessing the patient satisfaction with soft lined dentures and new dentures, questionnaires were used to assess retention, chewing satisfaction, comfort and general satisfaction with different dentures. It was found that at the time of delivery, 21 out of 22 patients were very satisfied with soft lined dentures and remaining one presented the lesser satisfaction score. In case of new dentures, all 22 cases were very satisfied. It may be due to the fact that the new dentures were made to restore the lost functions, lost facial muscle tone, vertical height and esthetics by following the accepted prosthodontics principles (Academy of Prosthodontics, 1995). So patient satisfaction on new denture was at maximum.

In this study, there was no statistically significant difference between patient satisfaction scores of soft lined and new dentures. The patients reported that they felt comfortable with soft lined dentures when wearing and chewing foods. Two patients complained of difficulty to clean the dentures after two weeks of soft lining. Within two weeks duration, soft liner materials did not exhibit changes in physical and mechanical properties, loss of adhesion to acrylic surface or accumulation of plaque and debris. Three out of 22 patients showed staining on their soft lined denture surfaces. One of them had the habit of betal quid chewing with denture and another one took coffee very frequently. Imirzalioglu (2010) showed that drinking of beverages and use of tobacco might be disadvantageous for long-term color stability of soft liner.

This study also revealed that patient satisfaction was achieved only in a single visit by soft lining the poorly fitting dentures. Retentive dentures provided stability, comfort and pain free denture wearing, so that chewing efficiency had improved dramatically. Although if new denture treatment is compulsory, soft lined old denture would provide well functioning state during the period of new denture fabrication. Modern soft lining materials have been improved recently and they become much better than previous materials. Some of the disadvantages have been eliminated so that soft liner can be retained for a longer period of time.

**CONCLUSION**

Within the limitation of this study, it can be concluded that by using soft denture liner, poorly fitting dentures might improve retention, masticatory efficiency and provide comfort and painless situation to the patients.

Although soft liner could not completely substitute standard new denture treatment, it might provide functionally satisfactory dentures only in a single visit.

**REFERENCES**


Abstract

The infection control in dentistry becomes very important issue since very infectious diseases such as Hepatitis-B & C, Acquired Immune Deficiency Syndrome (AIDS) can be cross-infected by way of saliva and blood during impression taking. This study was aimed to evaluate the dimensional accuracy of two alginate impression materials after immersion or spray disinfection with 0.5% sodium hypochlorite solution. Two commercially available alginate impression materials (Cavex and Phase) were manually mixed according to manufacturer’s instruction and impressions were taken on metal die and partially edentulous plastic model. Then impressions were disinfected with 0.5% sodium hypochlorite solution for 10 min by immersion or spray method. Control impressions were not treated. After washing under running water for one minute, impressions were cast in dental stone. Five impressions were made for each method (control, immersion or spray) and each alginate material. Measurements were done after final setting directly with digital caliper (for model) and with ImageJ software (NIH) in computer after taking images with digital microscope (for die) and then data were analyzed. There was no statistically significance difference in dimension of stone casts when methods of disinfection were compared. Disinfection of alginate impressions with 0.5% sodium hypochlorite solution by immersion or spray method for ten minutes has only very small effect on dimensional accuracy and both methods can be applied clinically.
Introduction

Impression materials are used to register or reproduce the form and relation of the teeth and the surrounding oral tissues. In Prosthodontics, impression material and prosthesis that have been exposed to infected saliva and blood pose a main source of cross-contamination and additional problems in controlling cross-infection between dental office and laboratories (Powell et al., 1990; Samaranayake et al., 1991). In view of the infectious carrier state of a significant proportion of the population and current trends in cross-infection control, disinfection of the impressions is seriously recommended by the American Dental Association (ADA) and the Centers for Disease Control to prevent possible transmission of infectious diseases. Despite the necessity of additional control procedures and disinfection during making and handling of dental impressions immediately after removal, it should be ensured that such procedures do not alter the dimensional accuracy of dental impressions. To issue guidelines regarding impression disinfection, the ADA determined the antimicrobial agents to be used for different impression materials and the time, dilution, and temperature needed for the optimal performance of each agent. The disinfecting process should be proper, but should not have an adverse effect on the dimensional stability or the surface detail of the impression. The purpose of this study was to evaluate the effect of the disinfection by spray or immersion on dimensional accuracy of two currently available, commonly used alginate impression materials in Myanmar.

Materials and methods

Alginate impression materials, Cavex (GC Corporation, Tokyo, Japan) and Phase (Badia Polesine (Rovigo)- Italy) were used. A custom made metal die made of stainless steel with three reference grooves and partially edentulous plastic model were used to make impressions. A rigid perforated acrylic tray more than 3 mm in thickness for metal die and perforated plastic tray for partially edentulous plastic model were used to load the impression materials. All the impressions were mixed according to manufacturer’s instructions in air conditioned room (25±1) °C. Impression was taken immediately after the material was completely mixed. The tray was held in situ until setting of impression material was complete and the tray was removed without bending. Impressions were then poured up in dental stone. Two measurements for each metal die cast were done by measuring width and depth of groove on the surface of the die. The linear dimensional changes were measured on the metal die cast by using an electronic digital caliper & USB microscope with 40 times magnification. For measurements of depth and width of lines, photographs were taken with USB microscope and saved in the personal computer. Then the measurements were done by Image J software (NIH, USA). Four measurements for partially edentulous plastic model were done by measuring inter-canine line, 2 canine-molar lines and inter-molar line. These lines were measured by using electronic digital caliper. All measured data were recorded in spreadsheet program (Microsoft Excel, Version 2007) and analyzed by using ‘Paired Samples T test’ in SPSS (Statistical Package for Social Science) statistical software. The values of change between measurement of reference points recorded from sample surface and measurements directly taken from test block surface were calculated and expressed as a linear change in ‘mm’. Positive values indicated that measurements obtained from sample surface were larger than the measurements directly obtained from test block surface. Negative values indicated that measurements obtained from sample surface were smaller than the measurements directly obtained from test block surface.

RESULTS

Figure (1) USB microscope (PC Camera PAC 7302)

Figure (2) Photomicrographs of (A) test block and (B) cast surface obtained with USB microscope showing the grooved lines

Figure (3) Photomicrographs of (A) test block and (B) cast surface obtained with USB microscope showing the grooved depth
Figure (4) The amount of change in the line’s width of stone cast. Values are shown as linear change in dimension (mm) and error bars denote standard deviation. (* p<0.05)

Figure (5) The amount of change in the line’s depth of stone cast. Values are shown as linear change in dimension (mm) and error bars denote standard deviation. (* p<0.05)

Figure (6) Digital slide clipper

Figure (7) Photograph of (A) partially edentulous plastic model and (B) stone cast surface of model.

Figure (8) The amount of change in Inter-canine (AB) width of stone cast. Values are shown as linear change in dimension (mm) and error bars denote standard deviation. (* p<0.05)

Figure (9) The amount of change in Inter-molar (CD) width of stone cast. Values are shown as linear change in dimension (mm) and error bars denote standard deviation.

Figure (10) The amount of change in right Canine-molar (AC) width of stone cast. Values are shown as linear change in dimension (mm) and error bars denote standard deviation.
Figure (11) The amount of change in Left Canine-molar (BD) width of stone cast. Values are shown as linear change in dimension (mm) and error bars denote standard deviation. (* p<0.05)

Table 1. Measurement of test block and stone casts

<table>
<thead>
<tr>
<th>Measurement point</th>
<th>Test block</th>
<th>Stone casts poured from Cavex</th>
<th>Stone casts poured from Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Control Mean (SD)</td>
<td>Immersion Mean (SD)</td>
</tr>
<tr>
<td>Line width</td>
<td>1.28</td>
<td>1.2412 (0.0281)</td>
<td>1.174 (0.0889)</td>
</tr>
<tr>
<td>Line depth</td>
<td>1</td>
<td>0.8216 (0.2318)</td>
<td>0.7544 (0.1112)</td>
</tr>
</tbody>
</table>

Table 1, figure 4 and figure 5 show the reference measurements of the metal test block, dental stone casts poured from impressions with Cavex and Phase impression materials after disinfection with 0.5% sodium hypochlorite solution.

Table 2. Measurement of test partially edentulous plastic model and stone casts

<table>
<thead>
<tr>
<th>Measurement point</th>
<th>Partially edentulous plastic model</th>
<th>Stone casts poured from Cavex</th>
<th>Stone casts poured from Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Control Mean (SD)</td>
<td>Immersion Mean (SD)</td>
</tr>
<tr>
<td>Inter-canine line(AB)</td>
<td>29.34</td>
<td>29.242 (0.3445)</td>
<td>29.474 (0.0288)</td>
</tr>
<tr>
<td>Canine-molar line(AC)</td>
<td>31.67</td>
<td>31.626 (0.3113)</td>
<td>31.534 (0.1394)</td>
</tr>
<tr>
<td>Canine-molar line(BD)</td>
<td>31.67</td>
<td>31.6 (0.2463)</td>
<td>31.538 (0.1424)</td>
</tr>
<tr>
<td>Inter-molar line(CD)</td>
<td>48.63</td>
<td>48.716 (0.1901)</td>
<td>48.524 (0.1184)</td>
</tr>
</tbody>
</table>

Table 2, figure 8, 9, 10 and 11 show the reference measurements of the partially edentulous plastic model, dental stone casts poured from impressions with Cavex and Phase impression materials after disinfected with 0.5% sodium hypochlorite solution.

Significant difference in depth of thin line between two different impression materials without being disinfected (p<0.05) were shown in figure 4 and 5. No significant differences were detected in width and depth of groove on dies after different disinfection methods.
Changes were also detected in inter-canine distance on model after spray disinfection and left canine-molar distance after immersion disinfection when Cavex and Phase impression materials are compared (p<0.05). These changes are shown in figure 8 and 11. However, there was no significance difference among control, immersion and spray disinfected method.

Discussion

Disinfection of impressions is important to prevent cross-infection between the patients, dental auxiliary staffs and laboratory staffs. Several studies have shown that microorganisms can be recovered readily from stone casts separated from contaminated impressions (Firtell et.al., 1972; Rowe & Forest, 1978; Leung & Schonfeld, 1983), and found that contaminated impressions can transfer bacteria to stone casts as a potential source of microbial cross-contamination. Consequently, it is essential for these items to be disinfected, ideally before sending them out of the clinic to the dental laboratory.

ADA (1994) recommends a ten-minute immersion in a 1:10 dilution (0.525%) of sodium hypochlorite solution for disinfection of irreversible hydrocolloid impressions. ADA (1996) also published guidelines for infection control in the dental office and commercial dental laboratory.

The disinfection of dental impression materials has become a critical topic of universal concern, because it may be the first link in microbial contamination during dental care. Irreversible hydrocolloid or alginate currently used in dentistry is the most popular dental impression material in everyday practice.

In our study, we used 0.5% sodium hypochlorite solution as disinfectant solution with two methods (immersion and spray methods). Sodium hypochlorite disinfectant (Bleaching solution) is inexpensive and convenient to use in the disinfection of irreversible hydrocolloid impressions. It has been shown to be effective against bacteria and viruses, including HIV (Bloomfield et.al., 1990) and Hepatitis B (Bond et.al., 1983).

Herrea and Merchant (1986) studied linear dimensional changes occurring after 10-mins and 30-mins immersion of complete arch irreversible hydrocolloid impressions in 0.5% and 1% sodium hypochlorite solution. They found no significant effect on the dimensional accuracy of the resultant stone casts.

To prevent possible distortion of the impression, a disinfection time should not exceed 10 minutes. Many studies have shown that irreversible hydrocolloid impressions are dimensionally stable when immersed in sodium hypochlorite solutions (Badrian et al., 2012; Saber et al., 2010; Hiruguchi et al., 2012).

The use of 0.5% sodium hypochlorite have been recommended and found to be effective. However, the effects of disinfection on dimensional accuracy of different alginate had been seen in this study. Based on the dimensional changes due to imbibitions and synersis properties of alginate impressions when immersed and sprayed with disinfectant solution or in contact with water, or when left in air some degree of dimensional changes had been expected.

In this study, Cavex gave better dimensional accuracy than Phase impression. Moreover, significant differences were detected in width and depth of groove on dies between two impression materials without being disinfected indicating that ability to record surface detail can be different depending on the impression material. Similar results were reported by Let and Nyan (2010) but Aroma seemed to be more accurate than Cavex. It may be interesting to test all available impression materials to compare their accuracy.

Significant differences were seen in intercanine distance (M-AB) after spray disinfection and left canine-molar distance (M-BD) on stone casts of plastic partially edentulous model after immersion in disinfection solution when two different impression materials were compared. Phase impression material showed more dimensional changes after immersion suggesting that spray disinfection method should be applied when Phase is used for impression making.

Nevertheless, there was no significant difference in dimensional change among control, immersion and spray disinfection methods when compared in each impression material suggesting that immersion or spray method for ten minutes has only very small effect on dimensional accuracy.

Conclusion

Disinfection of alginate impressions with 0.5% sodium hypochlorite solution by immersion or spray method for ten minutes has only very small effect on dimensional accuracy and both methods can be applied in dental clinics. However, different alginate products may have different degree of dimensional accuracy with or without disinfection. Therefore, choice of impression material is very important.
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Leung RL & Schonfeld SE. Gypsum casts as a potential source of microbial cross-contamination. J Prosthet Dent. 1983;29(2):210-211


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Abstract: The smear layer should be removed before root canal filling in order to improve sealing ability of obturated root canal. The aims of this study was to analyze and compare the smear layer removal on the dentinal tubules obtaining from SEM using SlickGel® (water based gel) and Glyde® (paste type) lubricating agents. Methods: 32 single rooted extracted human canine teeth were instrumented with Protaper® rotary system (Dentsply-Maillefer, Switzerland) using a crown-down technique and randomly divided into two groups (G1 and G2). In G1, SlickGel® was used as lubricating agent while Glyde® was used in G2. Both lubricating agents were used after each instrument change, followed by 5.25% sodium hypochloride (NaOCl) irrigations. After longitudinal sectioning, the dentinal walls were examined using scanning electron microscope (SEM) at 1000X magnification. Smear layer were scored on scanning electron micrograph using 1 x 1 cm grid scale, based on 5-step scale scoring method. Three calibrated investigators were evaluated the residual smear layer score on the dentinal walls. Data were statistically evaluated using Kruskal-Wallis and Mann-Whitney tests. Results: SEM study showed that SlickGel® was effective in removing smear layer compared to Glyde® on coronal and middle third of the root canal. However, the Mann-Whitney test showed in overall that there were no significant differences between two lubricating agents in smear layer removal (P > 0.05). Conclusions: None of the lubrication agent tested in this study, in combination with sodium hypochlorite irrigation, were able to completely remove the smear layer formed during the preparation of root canals.

INTRODUCTION

Existing methods of root canal shaping system, the action of endodontic instruments on dentine walls produce a layer of organic and inorganic material, is called the smear layer that may also contain bacteria and their by-products (Sen et al., 1995). The removal of smear layer has also been the focus of many studies to achieve the perfect biochemical preparation (Fukumoto et al., 2006; Heling and Chandler, 1998). This layer covers the instrumented walls and may prevent the penetration of intracanal medicaments into the dentinal tubules as well as interfere with the close adaptation of root filling materials to canal walls. Elimination of the smear layer results in; cleanliness of dentinal tubules in smoother canal walls with circular shape opening and slightly enlarged diameter of the tubules and, as a consequence, the root canal wall comes into closer contact with the filling material, which may penetrate the dentinal tubules, increasing adhesion and sealing capacity (Gettleman et al., 1991). The cleaning action of Ethylene-Diamine-Tetra-Acetic Acid (EDTA) in association with sodium hypochlorite solution results in cleaner canals, with a lower percentage of debris than that obtained using other irrigatants (Ruddle, 2002). In numerous investigations that mechanical instrumentation of the root canal does not result in perfectly cleaned canal walls as it leaves behind instrument-untouched areas as well as debris and a smear layer of organic and inorganic material (Mizrahi et al., 1975; Sen et al., 1995). The amount of smear layer produced during canal preparation by using rotary instruments, such as protaper nickel-titanium rotary files, has been reported as greater in amount than that produced by hand instrumentations (Czonstkowsky et al., 1990). Nontoxic chelating solutions are advocated for smear layer removal and EDTA is the most frequently used chelator in endodontics (Hulamann et al., 2003). Addition of a cationic detergent to the EDTA can reduce the surface tension of the liquid and increasing its
antiseptic capacity and it acts on the dentine walls to produce a clean surface, as well as open dentinal tubules (Gambarini, 2004). Different formulations of EDTA have been used as root canal irrigants to get expected smear layer free root canal walls such as combination with urea peroxide, is added to support debris to float out of from the root canal walls (Stewart et al., 1969). Some studies have shown that paste-type chelating agents, even as having a lubricating effect, do not remove the smear layer effectively (Lui et al., 2007; Iwanami et al., 2007). In a contrast, a study reported that the effect of liquid chelators has no effect on organic tissues in instrument-untouched root canal surfaces (Koskinen et al., 1980). Currently, the chelating agent EDTA combination with several concentration ranges of NaOCl is comprehensively used to remove the smear layer formed during the chemomechanical preparation of the root canal system. However, there are no comparative studies have been found comparing the action of this chelating agent in the efficiencies of water-soluble based gel form and paste type form of effective smear layer removal within our information received. The aim of this study was to evaluate and compare the smear layer removal on the dentinal tubules obtaining using SlickGel® (water based gel) and Glyde® (paste type) lubricating agents under scanning electron microscope.

MATERIALS AND METHODS

A total of 32 extracted maxillary and mandibular canine teeth with single root canal were used in this experiment. The selected teeth were stored in 1% sodium hypochlorite (NaOCl) solution for two days to remove any organic debris and thereafter they were stored in normal saline solution and then scrubbed with ultrasonic scalers for cleaning process.

Crown of all teeth were removed at the level of cemento-enamel junction using slow speed diamond saw with water coolant. The teeth were randomly divided into two groups as G1 and G2 of 16 teeth respectively.

During root canal preparation working length was determined by passing a size No.10 file carefully along the canal until tip of the file was just visible at the apical foramen, then subtracted 1 mm and the rubber stop was positioned at the measured length.

Preparation of the canal was continued with using nickel-titanium ProTaper (Dentsply, Maillefer, Switzerland) rotary instruments with a crown-down canal preparation technique, by the sequences of ProFile series, SX at the coronal third preparation then followed by the S1, S2 to the middle third and F1, F2 to the apical third. The apical seat was finished with F3 up to the working length was achieved. This sequence was continued until F3 file with 0.04 taper reached the working length. The canal was enlarged in a funnel shape from the coronal orifice towards the apical foramen with progressively smaller files until the desired length was attained.

During instrumentation G1, root canal irrigation was performed by alternate use of 5.25 % NaOCl and Glyde® lubricating paste after each instrument change. In group G2, root canal irrigation was performed by the alternate use of 5.25 % NaOCl and SlickGel® (water based) instead of Glyde®. Final irrigation was done by 2 ml of NaOCl in both groups. After instrumentation procedure was done, the canals were dried with paper points.

After canal preparation the teeth were vertically split into half for SEM evaluation. The teeth were grooved in bucco-lingually with a diamond disc, avoiding penetration into the root canal and then split in half by placing a small chisel into the grooves applying pressure. All specimens were immersed in neutral-buffered 10% formalin solution until SEM preparation. One of the teeth half was examined under SEM.

The specimens were dehydrated in a graded series of ethanol solutions, coated with gold-palladium, and then surfaces were examined under SEM (Gemini, LEO SUPRA 55VP Germany). Photomicrographs at 1000X for each root canal were taken (two in the coronal third, two in the middle third and two in the apical third) for comparative purposes. Six microscopic fields were randomly assessed in each third of a half of the root.

The specimens were scored from one to five using 5-step scale scoring method according to Hulsmann et al. (2003) as follow.

Score 1: No smear layer, dentinal tubules open.
Score 2: Small amount of smear layer, only few dentinal tubules open.
Score 3: Homogenous smear layer, only few dentinal tubules open.
Score 4: Complete covering by a homogenous smear layer, no open dentinal tubules.
Score 5: Heavy, non-homogenous smear layer covering the complete root canal wall.

Three different calibrated investigators examined and scored the photomicrographs. Evaluation was repeated twice for all specimens to ensure intra-
examiner consistency and Intraclass correlation coefficients (ICCs) analysis was used as a reliability test for the scoring of between the examiners.

**Statistical analysis**

The results of differences of smear layer score of prepared root canal surfaces within groups (G1 and G2) were statistically analyzed using the Kruskal-Wallis test. The differences of smear layer score at the different level of prepared root canal surfaces (coronal third, middle third and apical third levels) between groups (between G1 and G2) were using Mann-Whitney test.

**RESULTS**

The results of the median score of smear removal between G1 and G2 are shown in Table 1 (no significant result was observed between two groups). Comparison different score of smear layer removal at the coronal third, middle third and apical third level of prepared root canal surfaces within groups are shown in table 2 (no significant result was observed within the groups). Comparison of smear layer removal score between two lubricating agents at the different levels (coronal third, middle third and apical third) of prepared root canal surfaces are shown in table 3 (no significant difference in smear layer removal at three level of the root canals between two groups (P>0.05) was found).

**Group 1 (Glyde)**

The smear layer was removed from the coronal one third (Figure. 1) and middle one third (Figure. 3) exposed the dentinal tubules were open with enlarged tubule openings at the canal surfaces. In some specimens a small amount of smear layer was seen in the apical one-third with few dentinal tubules open (Figure. 5, score 2) but no specimens were found in no smear layer with opened dentinal tubules (score 1). Erosion of the dentinal tubules was observed in some photomicrographs.

**Group 2 (SlickGel)**

The specimens irrigated with SlickGel showed most of the smear layer was removed, and the dentinal tubules were clean and open in the coronal (Figure. 2) and middle (Figure. 4) third of the roots. More photomicrographs showed by the using of SlickGel that the smear layer cleaner and smoother canal walls than using of Glyde. In the apical one-third, few specimens were detected existing of no smear layer with dentinal tubules open at the tubules orifices. However, the majorities of the specimens were found existing in small amount of smear layer with only few dentinal tubules open (between score 2 and score 3).

The difference of smear layer score between two groups is given in Table 1. Statistical analysis showed no significant differences in cleanliness of the smear layer between G1 and G2 associated with the cleanliness of the coronal, middle and apical one thirds of the root canal walls (Table 3).

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Median</th>
<th>IQR</th>
<th>Z Statistics (df)</th>
<th>P* value</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1 (Glyde)</td>
<td>16</td>
<td>3.3</td>
<td>2.42</td>
<td>-1.25 (1, 30)</td>
<td>0.21</td>
</tr>
<tr>
<td>G2 (SlickGel)</td>
<td>16</td>
<td>2.83</td>
<td>2.33</td>
<td>-1.09 (1, 30)</td>
<td></td>
</tr>
</tbody>
</table>

a=Mann-Whitney test

**Table 2.** Comparison of smear layer removal on the dentinal tubule within groups in coronal, middle and apical third obtaining from SEM using SlickGel and Glyde lubricating agent.

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Median</th>
<th>IQR</th>
<th>(df)</th>
<th>P* value</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1 (Glyde)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronal</td>
<td>16</td>
<td>2.87</td>
<td>0.88</td>
<td>2</td>
<td>0.28</td>
</tr>
<tr>
<td>Middle</td>
<td>16</td>
<td>3.30</td>
<td>1.26</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apical</td>
<td>16</td>
<td>3.41</td>
<td>1.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>G2 (SlickGel)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coronal</td>
<td>16</td>
<td>2.33</td>
<td>1.10</td>
<td>2</td>
<td>0.58</td>
</tr>
<tr>
<td>Middle</td>
<td>16</td>
<td>2.91</td>
<td>1.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apical</td>
<td>16</td>
<td>3.23</td>
<td>1.23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

a= Kruskal-Wallis test
Table 3. Comparison the effect of smear layer removing between two lubricating agents at the different levels of prepared root canal surfaces.

<table>
<thead>
<tr>
<th>Level of prepared canal</th>
<th>Type of Lubricant</th>
<th>n</th>
<th>Median</th>
<th>IQR</th>
<th>Z statistic</th>
<th>P* value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coronal</td>
<td>G1 (Glyde)</td>
<td>16</td>
<td>2.87</td>
<td>0.88</td>
<td>-1.46</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>G2 (SlickGel)</td>
<td>16</td>
<td>3.33</td>
<td>1.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle</td>
<td>G1 (Glyde)</td>
<td>16</td>
<td>3.30</td>
<td>1.26</td>
<td>-0.73</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td>G2 (SlickGel)</td>
<td>16</td>
<td>2.91</td>
<td>1.45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Apical</td>
<td>G1 (Glyde)</td>
<td>16</td>
<td>3.42</td>
<td>1.50</td>
<td>-1.09</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td>G2 (SlickGel)</td>
<td>16</td>
<td>3.23</td>
<td>1.23</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*a = Mann-Whitney test

Figure 1. Root canal wall of coronal third after Glyde. Opening dental tubules with smear layer removal (Original magnification X 1000).

Figure 2. Root canal wall of coronal third after SlickGel. Opening dental tubules with smear layer removal (Original magnification X 1000).

Figure 3. Root canal wall of middle third after Glyde. Opening dental tubules with smear layer removal (Original magnification X 1000).

Figure 4. Root canal wall of middle third after SlickGel. Opening dental tubules with smear layer removal (Original magnification X 1000).
DISCUSSION

The ability to clean effectively the root canal surface is dependent on both instrumentation and irrigation (Ruddle, 2007). Irrigation plays a key role in successful debridgement and disinfection. An applying of the rotary instrumentation was resulted in a substantial amount of smear layer produced (Czonstkowsky et al., 1990). This smear layer consists of dentine particles and pulp tissue closely compacted against the root canal wall and extending into the dentinal tubules (McComb & Smith 1975; Mader et al. 1984; Bechelli et al. 1999). The smear layer produced by instrumentation should be removed, because of it could contain bacteria and leading to increase leakage of the canal filling (Yamada et al., 1983). Irrigation with antibacterial solutions or chelating agents has been recommended by many investigators to remove remnants of the prepared root canals as well as the smear layer; however, this recommendation did not create the expected smear-free surfaces in the apical third of the canal in most of the finding (Bechelli et al., 1999; Mozayeni et al., 2009). As a result of using two types of chelating agent in this study, the results did not show expected smear-free canal surfaces, especially at the apical third of the prepared canals (Table 3).

Liquid chelators, such as EDTA solutions in different concentrations or with different additional detergents and surfactants were used in order to soften dentine and consequently facilitate root-canal enlargement (Hulsmann et al., 2002). The use of paste-type chelating agents has been proposed with the primary aim to serve as gliding agents for rotary nickel-titanium files and to reduce the risk of instruments fractured in the canal (Hulamann et al., 2003).

Some studies stated that none of the canals investigated under the SEM were completely cleaned, but they found the greater part of the dentinal tubules were opened in the middle and coronal part of the root canals with widening of the dentinal tubules for liquid EDTA preparations.
(Abbott et al., 1991; Baumgartner and Mader, 1987; Gulabivala et al., 2005). This study agrees with their investigations, the cleaning effect was more prominent in the entire canal surfaces than by the using of water based chelating agent than paste type gel, even where as no statistically significant result was available between two groups. In this study, few of the photomicrographs showed using of water based gel (SlickGel) (Figure.6) gave cleaner surface than paste type (Glyde) (Fig.5) at the apical third, but there was no statistically significant (Table 3). This is probably due to the fact that more of the chelating pastes get in contact to the canal walls coronally than apically and, probably due to the factors declared by some studies; the decalcifying efficacy of chelating agents depends on the root length, application time and its ability of diffusion in the dentine (Sen et al., 1995; Dogan and Calt, 2001). Paste type chelating agents can give more lubrication action to rotary instruments and can also prevent dislodgement of instruments inside the canal. However, it probably may be more difficult to be washed out of the canal surfaces with final NaOCl irrigation and some residual parts may be left inside the root canal. Some of the photomicrographs (Figure.7) showed in this study, the erosion surfaces of prepared canal might be possible, were the evidence of unexpected effect of residual paste inside the dentinal tubules.

A study stated that the reducing of chelating power was detected when EDTA was associated with a wetting agent (De-Deus et al., 2006). Zehnder et al. (2005) suggested that the involvement of wetting agent in endodontic chelator solution does not improve the effectiveness of calcified tissue removal. The results of this study are in the close to the line with their studies. In this study, no significant results were obtained statistically at the different levels of root canal wall between two irrigation gels for within groups (Table 2) and between groups (Table 3). But some smear layer free surface using of SlickGel in apical third of the canal surfaces may be its more diffusible action to minute spaces than paste type, although duration of chelating action may be shorter than paste type. The limitation in this study was that examined only two selected areas of different levels of root canal surfaces under SEM at high magnification. Within the constraints of this factor, the use of the water based gel chelating agent (SlickGel) with ProTaper rotary system probably gave more smear layer free surfaces than paste type gel (Glyde) at the apical third of the root canals under SEM photomicrographs. However, this result was not statistically significant. What the results would be within the using of different rotary system had been performed in this study is a questionable. By the using of different rotary system with larger sample size that exploiting the results of these two types of chelating gel is recommended for further study.

**Conclusions**

According to the results of smear layer score between two lubricating agents, water based (SlickGel) lubricating agent was probably more effective for removing smear layer, especially at the apical third level than paste type (Glyde) but these results were statically not significant. Therefore, it can be concluded that none of the lubrication agents tested in this study, in combination with sodium hypochlorite irrigation, were able to completely remove the formed smear layer during preparation of root canals system.

**REFERENCES**


Endodontic Journal, 36; 810-830.


ABSTRACT

Even one strong painful dental procedure could be enough to cause dental fear/ anxiety and behavior management problems and can be the main barrier to successful completion of treatment. Behavioral shaping for dealing with a patient’s stress and pain have become interesting more common place in paediatric dentistry. The purpose of this study is to evaluate the effectiveness of audiovisual distraction and reinforcement techniques in behavioral shaping of paediatric dental patients. 60 children aged between 6 to 11 years were divided into 3 groups such as routine dental management technique (Group A), audiovisual distraction technique (Group B), and reinforcement technique (Group C) during extraction procedure. Children behavior observed by Frankl behavior rating scale was significantly different after behavior shaping in each group. Dental fear assessed by Child Fear Survey Schedule –Dental Subscale (CFSS-DS) scale was significantly different after behavior shaping in group B and C and also in group B by physiological response of children’s pulse rate. Moreover, between groups comparison of each behavioral management techniques were not significantly different in behavioral, psychological as well as physiological assessment of children. Therefore, this study showed that audiovisual distraction, reinforcement as well as routine dental management technique, all can be used as an effective noninvasive, non- pharmacological behavior management technique in management of paediatric dental patients.

Keywords: behavioral shaping, audiovisual distraction, reinforcement

INTRODUCTION

Many children perceive a visit to the dentists as stressful. Even one strong painful dental procedure could be enough to cause dental fear/ anxiety and be the main barrier to successful completion of treatment. So, dental anxiety may manifest as disruptive or non-compliance behavior at the time of appointment. The dentist should evaluate the child’s cooperative potential as part of the treatment plan. Moreover, consequences of dental fear and anxiety act as a barrier to treatment. Prevention of this negative development is a major task for the dentists. Therefore, identify these anxious dental patients and manage with appropriate behavioral management technique is essential. American Academy of Paediatric Dentistry (2008) has outlined ten behavior management methods for a child patient. Five consist of communicative management techniques, including: voice control, tell-show-do, positive reinforcement, distraction, and nonverbal communication. Also listed are the hand-over-mouth exercise (HOME) technique and physical restraint. The last three methods comprise pharmacological interventions such as conscious sedation, nitrous oxide, and general anesthesia. Today, there is increased scrutiny by both parents and dentists results in parental objection to techniques like HOME, physical restraint, and pharmacological intervention. As a result, many dentists are interested in noninvasive, acceptable alternatives (Kuhn & Allen, 1994).

The Effects of Behavior Shaping by using Audiovisual Distraction and Reinforcement Techniques

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2 Department of Paediatric Dentistry, University of Dental Medicine, Yangon, Myanmar
Distraction means shifting the attention of the anxious patient away from the anxiety provoking stimulus. Audiovisual distraction means let the child to watch television showing cartoons or anything that can attract the child attention during dental procedures, compared to audio distraction technique. Frere and Yorty, 2001 reported that virtual image audiovisual distraction is beneficial in reduction of fear and pain during dental prophylaxis patients.

Reinforcement may be defined as the strengthening of a pattern of behavior, which increases the possibility of that behavior being displayed in the future (Andlaw, 1996). AAPD (2008) described that positive reinforcement is an effective technique to reward desired behaviors and strengthen the recurrence of those behaviors. Stickers or toys act as positive reinforcers to improve the child cooperative level. Reinforcement is also the most frequently used behavioral management technique (Abushal, 2000).

Therefore, the purpose of this study is to compare the effectiveness of audio-visual distraction and reinforcement techniques in behavioral shaping of paediatric dental patients.

**MATERIALS AND METHODS**

According to the inclusion criteria, both gender of 60 healthy children aged between 6 and 11 years, who needed to extract his or her deciduous tooth under local anesthesia only by infiltration method had been selected from patients who recently attended at the Department of Paediatric Dentistry and Orthodontics, University of Dental Medicine, Yangon. Consent had been taken from patient’s parent on their first visit along with brief medical and dental history of patient. Selected children were randomized by block randomization and they had been divided into 3 groups of 20 each.

Children in group A had been managed by routine dental management technique (Tell show do technique). Children in group B had been managed by showing audiovisual presentation (cartoon) through television with DVD player during the entire extraction procedure for audiovisual distraction technique. Children in group C had been managed by reinforcement technique by giving rewards with sticker at extraction visits.

Each child had undergone 2 dental visits. In first visit, self-reported questionnaire form of dental fear: Child Fear Survey Schedule- Dental Subscale (CFSS-DS) (Berge et.al., 1998) was filled in the assessment form by the children before any procedure. In that visit, examination procedure, diagnosis and treatment planning was done by operator. Pulse oximeter was attached to the left thumb of the child during the whole procedure for measurement of pulse rate. Pulse rate was recorded after a period of one minute allowance for the stabilization of reading. After this, it was recorded again at the time of examination procedure by using mouth mirror and probe. Mean value of these 2 measurements was used for analysis. The overall behavior of the child at this visit was observed by operator as well as supervisor by using Frankl behavior rating scales (Badrinatheswar, 2010).

In second visit, extraction procedure was performed. At least 2 minutes after application of topical local anesthesia, local anesthetic solution was injected by infiltration technique using 30G short needle. Local anesthetic solution without adrenalin was used to avoid increasing pulse rate due to the presence of adrenalin. Pulse rate was recorded at the time of needle penetration and at the time of extraction. The mean value of these 2 measurements was used for analysis. The overall behavior of the child at this visit was observed by operator as well as supervisor by using Frankl behavior rating scales. After completion of the extraction procedure, self-reported questionnaire form of dental fear and anxiety (CFSS-DS) was filled in the assessment form by the children.

The value obtained were tabulated and subjected to statistical analysis.

**RESULTS**

For group A, concerning with the behavior observation, Frankl behavioral rating scale of children before behavior shaping was significantly different from after behavior shaping with p value of < 0.001(Table 1 ).

For group B, the behavior of children before behavior shaping was significantly different from after behavior shaping with p value of < 0.001 (Table 2).

For group C, comparison of the behavior of children before behavior shaping was significantly different from after behavior shaping with p value of < 0.001(Table 3).

Table 4 shows that there was no significant difference between group comparison of routine dental management (group A), audiovisual distraction (group B) and reinforcement technique (group C) after behavior shaping with p value of > 0.05.
Table 5 shows that there was no significant difference between audiovisual distraction (group B) and reinforcement technique (group C) after behavior shaping with p value of > 0.05.

In this clinical study, dental fear of the children is assessed by CFSS-DS before behavior shaping was not significantly different from after behavioral shaping in routine dental management technique with p value of > 0.05 (Table 6).

The table 7 shows that in group B, the dental fear of children before behavior shaping was significantly different from after behavioral shaping in audiovisual distraction group with p value of <0.05.

The table 8 shows that in group C, the dental fear of children before behavior shaping was significantly different from after behavioral shaping in reinforcement group with p value of <0.05.

There was no significant difference in dental fear of the children between routine dental management (group A), audiovisual distraction (group B) and reinforcement technique (group C). By Chi-Square test, p value was (>0.05) (Figure 1).

The dental fear of the children in audiovisual distraction technique (group B) was not significantly different from reinforcement technique (group C) after behavior shaping. By Fisher’s exact test, p value was (>0.05) (Figure 2).

While assessing the physiological response of the dental anxiety, the table 9 shows that dental anxiety of children within Group A experienced no significant mean difference in pulse rate following behavior shaping with p value of > 0.05.

The table 10 shows that dental anxiety of the children within Group B experienced significant mean difference in pulse rate following behavior shaping with p value of <0.05.

The table 11 also shows that dental anxiety of the children within Group C experience no significant mean difference in pulse rate following behavior shaping with p value of >0.05.

However, comparison of mean pulse rate related to the dental anxiety was not significantly different between routine dental management (group A), audiovisual distraction (group B) and reinforcement technique (group C) (Figure 3) by ANOVA, p value = 0.957 (NS).

Moreover, comparison of mean pulse rate in audiovisual distraction (group B) was not significantly different from reinforcement technique (group C) after behavior shaping (Figure 4) by Paired t test, p value = 0.690 (NS).

Table 1. Frankl behavior rating scale of children before behavior shaping and after behavior shaping in group A.

<table>
<thead>
<tr>
<th>Frankl behavior rating scale</th>
<th>Before behavior shaping</th>
<th>After behavior shaping</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>1(5%)</td>
<td>Deteriorate</td>
</tr>
<tr>
<td>3</td>
<td>20(100%)</td>
<td>15(5%)</td>
<td>Not different</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>18(90%)</td>
<td>Improved</td>
</tr>
<tr>
<td>Total</td>
<td>20(100%)</td>
<td>20(100%)</td>
<td></td>
</tr>
</tbody>
</table>

By Wilcoxon Sign Rank Test, p value < 0.001(S)

Table 2. Frankl behavior rating scale of children before behavior shaping and after behavior shaping in group B.

<table>
<thead>
<tr>
<th>Frankl behavior rating scale</th>
<th>Before behavior shaping</th>
<th>After behavior shaping</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>1(5%)</td>
<td>Deteriorate</td>
</tr>
<tr>
<td>3</td>
<td>20(100%)</td>
<td>3(15%)</td>
<td>Not different</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>16(80%)</td>
<td>Improved</td>
</tr>
<tr>
<td>Total</td>
<td>20(100%)</td>
<td>20(100%)</td>
<td></td>
</tr>
</tbody>
</table>

By Wilcoxon Sign Rank Test, p value < 0.001(S)

Table 3. Frankl behavior rating scale of children before behavior shaping and after behavior shaping in group C.

<table>
<thead>
<tr>
<th>Frankl behavior rating scale</th>
<th>Before behavior shaping</th>
<th>After behavior shaping</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>20(100%)</td>
<td>3(15%)</td>
<td>Not different</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>16(80%)</td>
<td>Improved</td>
</tr>
<tr>
<td>Total</td>
<td>20(100%)</td>
<td>20(100%)</td>
<td></td>
</tr>
</tbody>
</table>

By Wilcoxon Sign Rank Test, p value <0.001(S)
Table 4. Comparison of the children behavior after receiving routine dental management, audiovisual distraction and reinforcement techniques.

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean Rank</th>
<th>p value</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>31.88</td>
<td>0.697</td>
<td>NS</td>
</tr>
<tr>
<td>B</td>
<td>28.98</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>30.65</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

By Kruskal Wallis Test

Table 5. Comparison of children behavior after receiving audiovisual distraction (Group B) and reinforcement techniques (Group C) by using Frankl behavior rating scale.

<table>
<thead>
<tr>
<th>Group</th>
<th>Frankl rating scale after behavior shaping</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 (%)</td>
<td>3 (%)</td>
</tr>
<tr>
<td>B</td>
<td>1 (2.5%)</td>
<td>3 (7.5%)</td>
</tr>
<tr>
<td>C</td>
<td>0 (0%)</td>
<td>3 (7.5%)</td>
</tr>
<tr>
<td>Total</td>
<td>1 (2.5%)</td>
<td>6 (15%)</td>
</tr>
</tbody>
</table>

By Chi square test, p value=0.597 (>0.05) (NS)

Table 6. Comparison of dental fear and anxiety before and after behavioral shaping by using CFSS-DS for Group A.

<table>
<thead>
<tr>
<th>CFSS-DS</th>
<th>Before behavior shaping</th>
<th>After behavior shaping</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;38</td>
<td>17</td>
<td>19</td>
</tr>
<tr>
<td>&gt;=38</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

By Fisher’s exact test, p value = 0.150 (NS)

Table 7. Comparison of dental fear and anxiety before and after behavioral shaping by using CFSS-DS for Group B.

<table>
<thead>
<tr>
<th>CFSS-DS</th>
<th>Before behavior shaping</th>
<th>After behavior shaping</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;38</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>&gt;=38</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

By Fisher’s exact test, p value = 0.014 (S)

Table 8. Comparison of dental fear and anxiety before and after behavioral shaping by using CFSS-DS for Group C.

<table>
<thead>
<tr>
<th>CFSS-DS</th>
<th>Before behavior shaping</th>
<th>After behavior shaping</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;38</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>&gt;=38</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Total</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

By Fisher’s exact test, p value = 0.016 (S)

Table 9. Comparison of mean Pulse rate of before and after behavior shaping for Group A.

<table>
<thead>
<tr>
<th>Pulse Rate</th>
<th>Mean ± SD</th>
<th>Paired t test</th>
<th>p value</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>behavioral</td>
<td></td>
<td>1.604</td>
<td>.125</td>
<td>NS</td>
</tr>
<tr>
<td>shaping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>behavioral</td>
<td></td>
<td>101.15 ± 14.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>shaping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

By Paired t test

Table 10. Comparison of mean pulse rate of before and after behavior shaping for Group B.

<table>
<thead>
<tr>
<th>Pulse Rate</th>
<th>Mean ± SD</th>
<th>Paired t test</th>
<th>p value</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>behavioral</td>
<td></td>
<td>2.258</td>
<td>0.036</td>
<td>S</td>
</tr>
<tr>
<td>shaping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>behavioral</td>
<td></td>
<td>100.72 ± 13.53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>shaping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

By Paired t test

Table 11. Comparison of mean pulse rate of before and after behavior shaping for Group C.

<table>
<thead>
<tr>
<th>Pulse Rate</th>
<th>Mean ± SD</th>
<th>Paired t test</th>
<th>p value</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>behavioral</td>
<td></td>
<td>0.648</td>
<td>0.525</td>
<td>NS</td>
</tr>
<tr>
<td>shaping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>After</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>behavioral</td>
<td></td>
<td>99.87 ± 14.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td>shaping</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

By Paired t test
Figure 1. Comparison of dental fear of the children after receiving routine dental management, audiovisual distraction and reinforcement techniques.

Figure 2. Comparison of dental fear of the children after receiving audiovisual distraction and reinforcement techniques.
Figure 3. Comparison of pulse rate after receiving routine dental management, audiovisual distraction and reinforcement techniques

Figure 4. Comparison of pulse rate after receiving audiovisual distraction and reinforcement techniques
DISCUSSION

In this clinical study, before behavior shaping, all (100%) of the children: (51.66%) were boys and (48.34%) were girls had Frankl behavior rating scale 3: they had positive attitude towards dental treatment. They all show acceptance of treatment, willingness to comply with the dentist and children followed the dentist's directions cooperatively. This result was in accordance with the results found by Shinohara et.al. (2005). In their study, Frankl behavior rating scale 3 was the most common classification, followed by scale 1, 2 and 4.

After behavior shaping, only 5% in group A, and 15% in group B, and 15% in group C remained Frankl behavior rating scale 3: acceptance of treatment; willingness to comply with the dentist and patient follows the dentist's direction cooperatively after behavior shaping. Only 5% in each group A and B deteriorated to Frankl behavior rating scale 2: reluctant to accept treatment, uncooperative, withdrawal but not pronounced. In this study, Frankl behavior rating scale 4 was the most common behavior of the children observed after behavioral shaping in each group, followed by scale 3 and scale 2. Frankl behavior rating scale 1 was not found in this study, it may be likely due to the effects of behavior shaping techniques used in management of these children. According to these results, it appeared that the behavior of the children significantly improved following behavior shaping using routine audiovisual distraction and reinforcememt, as well as routine dental management technique. The findings in this study were supported by Florella, Sarale and Ram (2010). They reported that the application of audiovisual sedation technique in the children achieved not only avoidance of discomfort but also improvement of children positive behavior during treatment.

This study was in accordance with the study by Stokes and Kennedy (1980). They showed that tangible reinforcement was shown to reduce the level of uncooperative behavior of young children undergoing dental treatment. Pinkham (1999) also stated that for the children with cooperative behavior Tell show do method was the best method to accomplish the dental procedure.

Concerning with psychological reaction of dental fear of the children was assessed by using CFSS-DS. Before behavior shaping, 23.34% (n=14) of total children were reported as a clinical fearful condition (>=38), 6 out of 14 were boys and 8 out of 14 were girls. According to these results, girls showed more fear of dental treatment than boys. Klingberg and Broberg (2007) reviewed that both dental fear and anxiety and behavior management problem seemed to be more frequent in girls.

According to table 7 and 8, audiovisual distraction and reinforcement were effective in reduction of dental fear and anxiety of the children. The improvement in self-reported assessments might be due to the effects of behavioral shaping techniques or due to false positive reports from the children as they were relieved from the most distressful condition i.e., extraction procedure. Because self-reported questionnaires were reassessed after the extraction procedures.

Berge et.al. (1998) suggested that this was contrary to the design as CFSS-DS is supposed to be filled after treatment as it measure trait fear. This measure may give false results as a child may experience anticipatory anxiety prior to treatment that would be expressed in the filled questionnaire as opposed to fear relating to the dental procedure in this study.

However, there was no significant difference in between group comparisons of audiovisual distraction, reinforcement and routine dental management techniques. So, audiovisual distraction, reinforcement as well as routine dental management technique can be used as an effective technique for reduction of fear and anxiety of the child dental patients during dental procedure.

While assessing the physiologic response of dental anxiety, in group A, comparison of the mean pulse rate was significantly increased after behavioral shaping with p value of (.036). Actually it should be decrease after behavior shaping. Increased in mean pulse rate considered that physiologic pulse rate varies with age and age group participated in this group lies within wide range of age group (6-10 years). Physiologic pulse rate of (6 to 8 years) age group differs from (9 to 10 years) age group. This might also be attributed to the fact that audiovisual distraction technique would not help the children to gain control over the unpleasant stimulus and cannot give them a feeling of being in a familiar environment. It seemed plausible that television viewing as a relatively passive process would be less effective in distracting patients rather than either audio analgesia or video game techniques. With the passive television viewing procedure, the child had only to stop looking at the television screen to disrupt the distracting input. In fact, they suggested that the children only attended to the television programs sporadically. Their attention often returned to the ongoing dental procedure particularly when especially threatening stimuli
were present. A study by Sullivan et al. (2000) was in accordance with the results in this study. She concluded that the virtual reality had no significant effect on the behavior or anxiety of the child. However, during administration of the local anesthetic, the elevation of the pulse in virtual reality group was significantly less than in the non-virtual reality group.

According to these results, audiovisual distraction by using regular television could not sufficiently distract the children during extraction procedure. Instead of using regular television, using new audio-visual equipment, i.e., virtual reality eye glasses may be superior to traditional distraction because it offers more immersive images due to headsets that project the images right in front of the eyes of the user. It prevents the children from seeing what is happening in the real world and directs the focus on what is going on in the virtual world.

Florella, Sarale and Ram (2010) reported that the application of audiovisual eyeglass sedation technique in the children showed no changes in physiological parameters such as pulse, respiration and oxygen saturation during the dental procedure. The audio visual eyeglasses technique had the advantage to detach the child from the dental environment by cutting off most of the children into the sounds and sight of the dental instruments (e.g., syringe, needle, and drill) and transferred to the movies world. Frere and Yorty (2001) concluded that virtual image audiovisual system was beneficial in the reduction of fear, pain and procedure time for most of the patients during dental prophylaxis.

However, in reinforcement group there was no significant difference in mean pulse rate between before and after behavior shaping. Reinforcement can reduce physiologic responses related to dental fear and anxiety even during the extraction procedure. Abushal (2000); Oredugba and Sanu (2009) and Sharath and colleagues (2009) revealed that “Tell show do” which consist of explaining and demonstrating the operation of the instruments used during treatment, remains the most commonly used technique in paediatric dentistry.

Concerning physiologic response of the dental anxiety of the children, there was no significant difference occurred between audiovisual distraction, reinforcement and routine dental management techniques. So, audiovisual distraction, reinforcement as well as routine dental management technique can be used as effective noninvasive behavioral management techniques for reduction of dental anxiety of paediatric dental patients.

CONCLUSION

The results of this present study suggested that:

The behavioral scores showed that there were significantly improved in children behavior during extraction procedure in audiovisual distraction as well as reinforcement techniques.

Moreover, psychological assessment (self-reported questionnaire) of dental fear of the children was significantly reduced the clinical fearful condition of the children during extraction procedure in audiovisual distraction and reinforcement techniques. There was significant increasing of pulse rate during extraction procedure in
audiovisual distraction technique. This might be attributed to the fact that audiovisual distraction technique would not help to gain control over the most distress extraction procedure.

However, there was significant decreasing of pulse rate during extraction procedure in reinforcement technique with rewards (sticker). The thought that the child concerned would earn the sticker, might perhaps enhanced the effectiveness of the rewards reinforcement.

In summary, audiovisual distraction as well as reinforcement techniques are worthy to be practiced as an effective noninvasive, non-pharmacological behavioral management technique in management of paediatric dental patients.

REFERENCES


A Study Of Index Of Orthodontic Treatment Need And Perception Of Personal Dental Appearance Among Dental Students

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1 Department of Orthodontics, University of Dental Medicine, Yangon.
2 Department of Paediatric Dentistry, University of Dental Medicine, Yangon.

Index of Orthodontic Treatment Need (IOTN) is one of the most useful indices in assessing the severity of malocclusion and prioritizing the orthodontic treatment need. This study was aimed to investigate the relation between Index of Orthodontic Treatment Need (IOTN) and the perception of personal dental appearance. The investigation was carried out in University of Dental Medicine (Yangon) among randomly selected 100 students age between 16 to 23 years. An observational cross sectional descriptive study design was used to investigate the correlation between IOTN and the patient's perception of personal dental appearance. The IOTN index consists of two components; the Dental Health Component (DHC) determined by measuring the malocclusion on the study casts using the digital caliper and the Aesthetic component (AC) evaluated by using 10 intraoral color photographs of the AC scale. The perception of personal dental appearance was determined by asking the students with the closed-ended questionnaires. The Spearman's rank correlation test was used in the data analysis. The result showed that there was statistically significant correlation between the perception of personal dental appearance and Dental Health Component of IOTN (p<0.05). However, there was no statistically significant correlation between Aesthetics Component of IOTN and their perception. The findings of this study indicated that the DHC was found to be quick, well adapted, easy to use and reliable to describe the need for orthodontic treatment. The AC did not reflect the patient's perception and the AC alone failed to identify the orthodontic treatment need.

INTRODUCTION

Orthodontic treatment is an elective treatment that depends on the perception of both the patient and the treating orthodontist. The effective management of the public health care system requires assessing not only demand, but also need for orthodontic treatment. Selection of patients to ensure that treatment is provided to the subjects with the greatest need is especially important for countries with limited human and financial resources. Criteria for treatment need are different in many countries and depend on prevalence of malocclusion, health care system, socio-economic factors, and cultural background. Information on the perception of malocclusion can be used to influence decision making on the orthodontic services to be provided, human resource training needs, the design of treatment facilities, continuing education for oral health personnel, public health programs, screening for treatment priority, and resource planning. This information can also be used for patient education and information.

Over the year, a variety of indices have been developed to assist professionals in categorizing malocclusion according to the level of treatment need. Some examples of these indices are Treatment Priority Index (Grainger, 1967), Handicapping Malocclusion Assessment Record (Salzmann, 1968), and the Occlusal Index (Summers, 1971). These indices were developed in the late 1960s and early 1970s, primarily for epidemiological purposes, but they have also been used to determine treatment priority. Also these...
indices take no account of the socio-psychologic and physiologic effects of malocclusion.

The recently developed orthodontic index, Index of Orthodontic Treatment Need (IOTN), is being used in orthodontic treatment need and priority. IOTN includes two components; Dental health component recording need for treatment on dental health and Aesthetic components recording the aesthetic impairment, by implication, the justification for treatment on socio-psychological grounds. So, this method not only gives information on malocclusion traits but also made amenable for studying the influence of socio-psychologic effect on the need and demand for orthodontic treatment. The Index of Orthodontic Treatment Need (IOTN), described by Brook and Shaw (1989) and modified by Richmond (1990) has been gaining national and international recognition as a method of objectively assessing treatment need. The IOTN was introduced as a combination of the SCAN scale (Standardized Continuum of Aesthetic Need; Evans and Shaw, 1987) and the index used by the Swedish Dental Health Board (Linder- Aronson, 1974). The index comprises two parts; the dental health component (DHC) and the Aesthetic Component (AC). The dental health component (DHC) have 5-grade scale, from grade-1 (there is no need for treatment) up to the grade-5 (there is a great need for treatment). The DHC may be applied both clinically and to study model. The aesthetic component (AC) consists of 10-grade scale, illustrated by color intraoral photographs. The photographs represent different levels of dental attractiveness grade-1 representing the most attractive and grade-10 the least attractive dentitions.

In Myanmar, there is no previous study to investigate the relation between Index of Orthodontic Treatment Need (IOTN) and perception of personal dental appearance. Therefore, this study was carried out to establish the relation between IOTN and perception of personal dental appearance among dental students. The findings from this study would be expected to predict whether IOTN actually reflects the patient's perception of their personal dental appearance.

**MATERIALS AND METHODS**

Equal gender of 100 dental students attending at University of Dental Medicine (Yangon), were randomly collected. 20 students from each class were selected according to selection criteria. Those who had been selected for the study were asked to fill the questionnaires for assessing the perception of their personal dental appearance (Proforma-1).

Index of Orthodontic Treatment Need (Brook and Shaw, 1989) was used to assess the need for orthodontic treatment. IOTN consists of two components, Aesthetics Component (AC) and Dental Health Component (DHC). Ten color photographs were shown for assessing Aesthetics Component of IOTN. The following questions were asked (Lunn et. al 1993). ‘Here is a series of 10 photographs showing a range of dental attractiveness, number 1 is the most and number 10 the least attractive arrangement of teeth. Where would you put your teeth on this scale?’ The participants assessed their own teeth in the mirror using a color photograph of Aesthetics Component. The AC grade was rated according to IOTN (Figure-1).

Dental Health Component (DHC) was assessed clinically by using mouth mirror and periodontal probe. Upper and lower impressions were taken on the selected subjects with alginate impression material by using perforated stock tray. The impression was made immediately with stone plaster. The subject’s registration number on the questionnaire form was copied with an indelible pencil onto their respective models. Only the perfect maxillary and mandibular casts which were able to occlude in the intercuspal position were proceeded for malocclusion assessment (DHC). The assessment of malocclusion was made on the models by single operator using the sliding caliper. A digital caliper with a Vernier scale that provides a precision reading to the nearest 0.01 mm was used to measure the teeth. The sharp tips of the caliper facilitates accuracy of measurements. The assessment was done by the single operator, for 2 times, with one week interval between each assessment.
Proforma (1) Questionnaires (Perception of personal dental appearance)

1. Are you satisfied with your dental appearance? 0 1 2
   - 0 = not satisfied
   - 1 = satisfied
   - 2 = very satisfied

2. Are you satisfied with your upper front teeth? 0 1 2
   - 0 = not satisfied
   - 1 = satisfied
   - 2 = very satisfied

3. Are you satisfied with your lower front teeth? 0 1 2
   - 0 = not satisfied
   - 1 = satisfied
   - 2 = very satisfied

4. Do you like the appearance of your face? 0 1 2
   - 0 = not satisfied
   - 1 = satisfied
   - 2 = very satisfied

Statistical correlation between Index of Orthodontic Treatment Need (DHC and AC) and the subjective perception of their personal dental appearance was calculated by Spearman's correlation test.

RESULTS

Table-1. Perception of personal dental appearance in relation to the Dental Health Component (DHC) of IOTN
Table-2. Correlation between Dental Health Component (DHC) of IOTN and the perception of personal dental appearance according to the Spearman's correlation

<table>
<thead>
<tr>
<th>Parameters</th>
<th>N</th>
<th>Spearman Correlation</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>DHC grades and perception</td>
<td>100</td>
<td>0.249</td>
<td>0.013</td>
</tr>
</tbody>
</table>

Spearman Correlation value was 0.249 and with p value of 0.013 (*p<0.05), there was statistically significant correlation between DHC and the perception of their personal dental appearance.

Table-3. Perception of personal dental appearance in relation to the Aesthetic Component (AC) of IOTN

<table>
<thead>
<tr>
<th>Perception with personal dental appearance</th>
<th>AC</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No need of treatment</td>
<td>Moderate / Borderline need</td>
</tr>
<tr>
<td>Very satisfied</td>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>Satisfied</td>
<td>67</td>
<td>3</td>
</tr>
<tr>
<td>Not satisfied</td>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>94</td>
<td>4</td>
</tr>
</tbody>
</table>

Table-4. Correlation between Aesthetics Component (AC) of IOTN and the perception of personal dental appearance according to the Spearman's correlation

<table>
<thead>
<tr>
<th>Parameters</th>
<th>N</th>
<th>Spearman Correlation</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC grades and perception</td>
<td>100</td>
<td>0.119</td>
<td>0.239</td>
</tr>
</tbody>
</table>

Spearman Correlation value was 0.119 and with p value of 0.239 (p>0.05). The result showed that there was no statistically significant correlation between AC and the perception of their personal dental appearance.

**DISCUSSION**

The desire for treatment by individuals who are dissatisfied with their appearance underlines most orthodontic treatments. For this reason, the orthodontist’s objective is not only to improve the function...
and the appearance but also to ensure the patient’s satisfaction at the end of treatment. Since the patient’s satisfaction is important to orthodontists, the success of orthodontic treatment depends on a balance between the patient’s perceived needs and orthodontist’s objective assessment of the patient’s orthodontic problems. Thus, a more standardized procedure is needed for relating objective need and subjective need for determining the orthodontic treatment need.

In the present study, 28% of subjects were found to be in need treatment category according to DHC. A high percentage of moderate need (48%) was found and 24% of subjects were seen in no need treatment category.

Brook and Shaw (1989) found that the DHC proportions in 333 school children being 11-12 years old from England were 32.7% for definite need, 32.1% for moderate need and 35.1% for no treatment need. Mandall et al. (2001) studied on sample of 434, 14-15-year old children from schools in Manchester. The orthodontic treatment need of these students was measured with IOTN. This study found that 18% of students were found to be in definite need treatment, 34% in moderate need and 48% in no treatment need. Ali H Hassan (2006) studied on sample of 743 adults in the western region of Saudi Arabia who was examined for orthodontic treatment need using IOTN. The results of DHC revealed that 71.6% had definite need for orthodontic treatment, 13.2% had moderate treatment need and 15.2% had no treatment need.

It can be concluded that the percentage of definite need for orthodontic treatment in the present study was very similar to the results of Brook and Shaw study. However, the percentage of moderate treatment need in this study was comparatively higher than the previous studies (Brook and Shaw, 1989; Mandall et. al., 2001; Ali H Hassan, 2006). This high percentage of moderate orthodontic treatment need indicates the importance of improving awareness of malocclusion and preventive orthodontic treatment to reduce the need for orthodontic treatment. If there was an early diagnosis and a timely orthodontic referral, these would help to reduce the possibility of more complex treatments, thus saving the treatment time and the cost.

When Aesthetic Component of IOTN was assessed, the majority of the subjects tended to rate their dentition towards the more attractive end of the scale. So, the no need treatment resulted in 94%. 4% of subjects were found to be in moderate need. Only 2% of subjects showed definite need for orthodontic treatment.

The percentage of AC for no treatment need found by Brook and Shaw (1989) was 58.2%, 36.3% was moderate need and 5.4% was definite need for orthodontic treatment. Mandall et. al., (2001) found that higher percentage: 72% was seen in no need treatment, 19% in moderate need and only 9% in definite need for orthodontic treatment. Ali H Hassan (2006) showed that 60.6% expressed no need for treatment, while 23.3% expressed moderate need and 16.1% expressed definite need for orthodontic treatment according to AC. This revealed that the definite need value of the present study was nearly in line with those values found by Brook and Shaw, 1989; Mandall et. al., 2001. But, the percentage of AC for no need treatment category in the present study was obviously higher than the previous studies (Brook and Shaw, 1989; Mandall et. al., 2001; Ali H Hassan, 2006).

The variations between the present AC scores and those found in the literature may be the result of possible cultural differences regarding the aesthetics perceived by different populations. On the other hand, it might happen that the cut-off point for no need and moderate need grades (Grades 4 and 5) might sometimes be chosen differently in this study. In the similar manner, Stenvik et. al., (1997) determined that the cut-off point for aesthetic treatment need in moderate grade was used differently. As AC is more subjective, it also brings difficulties in assessing some parameters, such as degree of overjet and overbite. In Kyaw Thein study (1994), overjet and overbite were significantly associated with the need for orthodontic treatment. Moreover, the photographs of AC showed only front view. Overjet and overbite were better portrayed in side or three dimensional views. On the other hand, the standard photographs of AC did not show common orthodontic problems such as open bite and crossbite.

On determining the perception of personal dental appearance, the majority of the students examined (72%) expressed satisfaction with their personal dental appearance. Only 10% of students were not satisfied with their dental appearance which was perceived to be connected with malocclusion. However, 18% were very satisfied with their personal dental appearance.

The perception of personal dental appearance is different between the younger and older students because of difference in knowledge about orthodontic treatment. However, compared with the other lay persons, the dental students have greater knowledge to orthodontic treatment. So, the perception of personal dental appearance
may vary in different knowledge and different social class level. Information on the perception of personal dental appearance can be used for decision making on the orthodontic services, the design for treatment facilities and screening for treatment priority. Therefore, it is necessary to investigate the perceptual awareness of malocclusion before an orthodontic care system is developed.

In the present study, there was statistically significant correlation between DHC and the perception of personal dental appearance among dental students (p< 0.05). The results of this study showed that dissatisfaction with personal dental appearance was generally related to the severity of occlusal irregularities. This finding underlines the usefulness of the DHC when evaluating need for treatment.

However, there was no statistically significant correlation between AC and the perception of personal dental appearance. So, it cannot be suggested that a more negative psychosocial response might be a result of poorer aesthetic tooth appearance.

These findings indicate that the patient's perception of personal dental appearance was more related to the objective orthodontic treatment need (DHC) than the subjective orthodontic treatment need (AC). This is because the DHC score is based on a grade assigned to the single 'worst' occlusal trait, which makes it an easy and reliable index to use. As regards the AC, the standard photographs of the AC do not show three dimensional views of the dentition; besides, accurate specifications for recording are not prescribed in these photographs. So that most of the subjects had difficulties in assessing their antero-posterior discrepancies such as increased overjet. Resulting from above reason, there is insignificant correlation between photographs number 4 and 9 showing increased overjet and the actual condition of the subjects.

On the other hand, very satisfied and satisfied students selected grade 1 or 2 on the AC scale significantly more than dissatisfied individuals. Dissatisfied students selected grade 3 or higher.

It would appear that the separate interpretation of grades 1-2 and 3-4 gives a more realistic perception of dental aesthetics (e.g. 1-2 'no need'; 3-4 'slight need'). The alternative would be to move the category 'borderline need' two grades lower (e.g. grades 3-7).

In a study of 12 years old school children in Poland using the IOTN, Grzywacz (2003) found that the correlation between dental concern and the AC would be improved if the borderline need category was split into two parts (e.g. 1-2 'no need'; 3-4 'slight need'). In addition, there was a little difference in dental aesthetics between the photographs 5 and 6 on the one hand, 7 and 8 on the other. Therefore, the AC of IOTN may benefit from being modified to include only eight photographs rather than ten. A suggested sequence of photographs would be 1, 2, 3, 4, 6, 8, 9 and 10. Photographs would be sequentially numbered from 1 to 8. However, further investigation may be required for validation of these photographs.

Therefore, it could be concluded that the DHC proved to be quick, well adapted, easy to use and reliable method to describe the need for orthodontic treatment. The AC did not reflect the patient's perception. In addition, the AC alone failed to identify the orthodontic treatment need. For all these reasons, the IOTN may be adequate for public health planning and epidemiological purposes. IOTN also reflects the common professional opinion.

The evaluation based on the correlation between the perception and IOTN may not be sufficient enough for deciding the treatment need. Because the other factors including social needs, economic considerations, and attitudes to orthodontic appliances are to be considered. They may interfere with treatment planning since those factors do not always coincide with the professional evaluation of treatment need. Therefore, further studies based on larger sample size in the community investigating the patient's perception and his or her concern regarding orthodontic treatment should be carried out in order to enhance the IOTN efficacy.

CONCLUSION

The DHC proved to be quick, well adapted, easy to use and reliable method to describe the need for orthodontic treatment. The IOTN may be an effective tool in epidemiological purposes and third party payment system (e.g. the National Health Service, local government agency or public insurance).

References


Beglin, F.M., (2001) A comparison of the reliability and


An evaluation of the force delivery system by different types of elastomeric chains

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2 Department of Orthodontics, University of Dental Medicine, Mandalay, Myanmar

Abstract
This study was carried out to evaluate the force delivery system of different types of commercially available elastomeric chains in a simulated oral environment. Four clear elastomeric chains: Ormco-closed, Ormaer-closed, Ormaer-open, and Ormaer-open medium were tested. Fifteen samples were taken from each elastomeric chain. The length of elastomeric chains, approximately 70-75% of constant distance (i.e. 24 mm) was used. They were stretched and submerged under water in water bath at 37 °C for 28 days. The forces were measured at 0 hour (initial), 1 hour, 24 hours, 3 days, 7 days, 14 days, 21 days, and 28 days. The stretched length (24 mm) was decreased 0.25 mm per week to simulate tooth movement for four weeks. From this study, initial forces: Ormco-closed (275 g), Ormaer-open (400 g), Ormaer-closed and Ormaer-open medium (350 g) were noted. During the first hour, all elastomeric chains showed remarkable reduction (36-53%) in force delivery. Ormco-closed maintained higher percentage of remaining force and Ormaer-open maintained less force than others. Ormaer-closed and Ormaer-open medium showed the same force decay. Paired t-test was used to compare the force decay in each elastomeric chain during the study period. There was significant difference in force decay at each interval except from 21-28 days interval of Ormaer-open and Omaer-open medium. One way ANOVA was used to compare percent reduction of force and remaining percentage of force between different elastomeric chains during the study period. There was no significant difference in the force delivery between Ormaer-closed and Omaer-open medium during the study period. Therefore, elastomeric chains can be affected by both temperature and moisture, and causing force decay. Ormco-closed in length approximately 70-75% of the canine retraction distance can produce the proper force for canine retraction (i.e. 100-350 g). These results suggested that the Ormco-closed chain was better material of choice for clinical use.

Introduction
Orthodontic treatment with fixed appliance commonly involves moving teeth along an arch wire. Clinicians select a force delivery system for retracting canines or closing residual extraction spaces. For this purpose the applied force will be of sufficient duration to achieve tooth movement in an efficient and effective manner. The optimal magnitude required for canine retraction is still not yet in final conclusion. Many factors affect canine movement such as the root surface area of tooth to be moved, density of the bone, friction from brackets and arch wire and age of the patient. Even though orthodontists generally agree that optimal force refers to the lightest continuous force compatible with physiologically tooth movement. As for canine movement, many studies suggest that the force magnitudes
required to bodily move canines are estimated to range from 100 to 350g (Storey and Smith, 1952; Hixon et al., 1969; Boester and Johnston, 1974). As space closure is a routine procedure in orthodontic practice, the force needed to achieve space closure can be obtained by using the various of force delivery systems including closing loop arch wires, coil springs, magnets, orthodontic elastics and elastomeric chains. Each of these systems has different advantages and disadvantages. Clinicians can control the level of force for the space closure with closing loop arch wire, but it may impinge on the patient’s gingiva and irritate the mucosa. Magnets are often bulky, expensive and difficult to keep clean. Coil springs can generate a continuous force but are also difficult to keep clean. The recent introduction of nickel-titanium coil springs, which theoretically provide a low, but constant force, may make this ideal more readily attainable, although not all coil springs demonstrate super elastic behavior (Melson et al., 1994). Although nickel-titanium coil springs have proved to be clinically effective (Samuels et al., 1993; Sonis, 1994), they have a high cost. Elastomeric chains are inexpensive, relatively hygienic, easily applied by clinician and require little or no patient cooperation. Therefore, elastomeric products tend to remain the system of choice for most operators, certainly for those involved with this study. They also allow patients participation through their choice of colour selections. Therefore, elastomeric chains are popular among orthodontists. Elastomeric chains were introduced to the dental profession in the 1960s and have become an integral part of many orthodontic practices. They are used to generate force for canine retraction, diastema closure, rotational correction and arch constriction. However elastomeric chains are not without their disadvantages. As elastomeric chains are themselves elastic, they could be easily extended and may have exceeded the elastic limit especially when exposed to an oral environment. Because after absorbing water and saliva, they become permanently stained and suffer a breakdown of internal bonds that leads to permanent deformation and lose force. It is well known that elastomeric products lose force over time, even under dry conditions, and their properties can be changed by both moisture and temperature. Therefore, force decay in these materials is significant and has been a clinical problem.

**Materials and methods**

This study is in vitro, comparative study of the different products with repeated measure of outcomes. Four clear elastomeric chains:Ormco-closed, Ormaer-closed, Ormaer-open, and Ormaer-open medium were tested in this study which are commercially available in Myanmar (Fig., 1,2). The clinical uses of elastomeric chains are varied. For study purpose, the chain material was used to simulate canine retraction into the site of an extracted first premolar. For this, 16 cm long, 1cm thick two clear acrylic plates were constructed with the aid of an aluminium frame. One plate received 15 aligned marks space 10 mm apart from each other were drilled with a carbide round bur (1.019 mm) at slow speed to a depth of 5 mm. In the holes, fifteen pairs of stainless steel pins cut from 0.040-inch orthodontic wire were adjusted and fixed with clear acrylic resin, resulting in pins with standard height of 10mm and placed in rows. In each row, stainless steel pin was bent at 5 mm to simulate the auxiliary hook of the first molar tube (molular hook pin) and another pin was left straight to simulate integral hook of the canine bracket (canine hook pin). Two orthodontic expansion screws were inserted between two plates at each end for closing the distance between the 15 pairs of stainless steel pin. Four pair of plates were prepared, one for each product, with a constant distance of 24 mm (Nattrass et al., 1998; Soares Santos, 2007) between each row of pin was set to simulate canine retraction distance (i.e. distance between the auxiliary hook of the first molar tube and integral hook of the canine bracket):The length of elastomeric chain was used at approximately 70-75% (Poolkerd, 2009) of the constant distance (i.e., 24 mm). According to pilot study 6 loops for Ormco-closed, 6 loops for Ormaer-closed, 5 loops for Ormaer-open and 5 loops for Ormaer-open medium were included (Fig., 3). The samples were prepared by cutting with the use of sharp ligature cutter. Care were taken to avoid extended handling during cutting as this may have incorporated stresses in the material prior to testing. The 15 samples of each product were stretched and placed on stainless steel pins by orthodontic force gauge and submerged under water from water bath at 37°C (Bonyanate, 2004; Lu et al., 1993; Andreasen and Bishara, 1970) for 28 days, (Fig., 4). The name were recorded on the each plate as A, B, C, and D for Ormco-closed, Ormaer-closed, Ormaer-open, and Ormaer-open medium elastomeric chain, respectively. The samples were numbered from 1 to 15 on each pair of pins. The force were measured at 0 hour (initial), 1 hour, 24 hours, 3 days, 7 days, 14 days, 21 days, and 28 days. The stretched length (24 mm) was decreased 0.25 mm per week to simulate tooth movement for four weeks and done before the measuring procedure. In measurement, one end of the chain at the molar hook pin were not removed throughout the procedure, while the other end was stretched by the orthodontic force gauge to the canine hook pin along the line between two pins. Once the
orthodontic force gauge touches the canine hook pin, the force value were recorded (Fig., 5, 6). During measuring procedure, each plate was removed from water bath for 5 minutes to record the data at every measuring period. Instrument calibration was also done before every measuring procedure.

Results

![Closed elastomeric chains](image1)

![Open elastomeric chains](image2)

![Open Medium elastomeric chains](image3)

Figure (1) Types of elastomeric chains

Figure (2) Commercially available elastomeric chains
Figure (3) length of elastomeric chains

Figure (4) Tested elastomeric chains in water bath
Figure (5) Orthodontic Force Gauge

Figure (6) measuring with orthodontic force gauge
Figure (7) Graph of force delivery of four elastomeric chains through 28 days

Figure (8) Graph of percentage of force delivery of four elastomeric chains through 28 days
Table (1) Significance of force decay in each elastomeric chain with time

<table>
<thead>
<tr>
<th>Time</th>
<th>DIFFERENCE/SIGNIFICANT LEVEL</th>
<th>Ormco-closed</th>
<th>Ormaer-closed</th>
<th>Ormaer-open</th>
<th>Ormaer-open medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1 hr</td>
<td>36.4*</td>
<td>53.5*</td>
<td>56.2*</td>
<td>53.3*</td>
<td></td>
</tr>
<tr>
<td>1-24 hr</td>
<td>-</td>
<td>14.3*</td>
<td>-</td>
<td>14.3*</td>
<td></td>
</tr>
<tr>
<td>24hr-3 days</td>
<td>14.3*</td>
<td>-</td>
<td>14.3*</td>
<td>16.7*</td>
<td></td>
</tr>
<tr>
<td>3-7 days</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>7-14 days</td>
<td>-</td>
<td>-</td>
<td>16.7*</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>14-21 days</td>
<td>16.7*</td>
<td>20.0*</td>
<td>20.0*</td>
<td>20.0*</td>
<td></td>
</tr>
<tr>
<td>21-28 days</td>
<td>-</td>
<td>1.7n.s</td>
<td>0.8n.s</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* p< 0.05: Differences of force delivery between different time of each Ormco-closed re statistically significant at \( \alpha \) 0.05 level.

n.s (not significant): There are no differences of force delivery between different time of each product.
- : No change in force

Table (2) Significance of difference in percent reduction of force between elastomeric chains with time

<table>
<thead>
<tr>
<th>Time</th>
<th>DIFFERENCE/SIGNIFICANT LEVEL</th>
<th>Ormco-closed and Ormaer-closed</th>
<th>Ormco-closed and Ormaer-open</th>
<th>Ormco-closed and Ormaer-open medium</th>
<th>Ormaer-closed and Ormaer-open</th>
<th>Ormaer-open and Ormaer-open medium</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>diff</td>
<td>p value</td>
<td>diff</td>
<td>p value</td>
<td>diff</td>
<td>p value</td>
</tr>
<tr>
<td>0-1 hr</td>
<td>-17</td>
<td>&lt;0.001</td>
<td>-19.9</td>
<td>&lt;0.001</td>
<td>-17</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>1-24 hr</td>
<td>-14.3</td>
<td>&lt;0.001</td>
<td>0.0</td>
<td>1.0</td>
<td>-14.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>24hr-3 days</td>
<td>-2.4</td>
<td>&lt;0.001</td>
<td>0.0</td>
<td>1.0</td>
<td>-2.4</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>3-7 days</td>
<td>0.0</td>
<td>NA</td>
<td>0.0</td>
<td>NA</td>
<td>0.0</td>
<td>NA</td>
</tr>
<tr>
<td>7-14 days</td>
<td>0.0</td>
<td>1.0</td>
<td>-16.7</td>
<td>&lt;0.001</td>
<td>0.0</td>
<td>1.0</td>
</tr>
<tr>
<td>14-21 days</td>
<td>-3.3</td>
<td>&lt;0.001</td>
<td>-3.3</td>
<td>&lt;0.001</td>
<td>-3.3</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>21-28 days</td>
<td>0.0</td>
<td>1.0</td>
<td>-1.7</td>
<td>0.59</td>
<td>-0.8</td>
<td>1.0</td>
</tr>
</tbody>
</table>

diff : mean difference
p< 0.05: There are significant differences between two products' remaining forces
NA   : not applicable
Table (3) Significance of difference in remaining forces (%) between different elastomeric chains with time

<table>
<thead>
<tr>
<th>Time</th>
<th>DIFFERENCE/SIGNIFICANT LEVEL</th>
<th>Ormco-closed and Ormaer-closed</th>
<th>Ormco-closed and Ormaer-open</th>
<th>Ormco-closed and Ormaer-open medium</th>
<th>Ormaer-closed and Ormaer-open</th>
<th>Ormaer-closed and Ormaer-open medium</th>
<th>Ormaer-open and Ormaer-open medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 hr</td>
<td></td>
<td>17.0*</td>
<td>19.9*</td>
<td>17.0*</td>
<td>2.9*</td>
<td>0.0*</td>
<td>-2.9*</td>
</tr>
<tr>
<td>24 hr</td>
<td></td>
<td>23.6*</td>
<td>19.9*</td>
<td>23.6*</td>
<td>-3.8*</td>
<td>0.0*</td>
<td>3.8*</td>
</tr>
<tr>
<td>3 days</td>
<td></td>
<td>21.2*</td>
<td>17.0*</td>
<td>21.2*</td>
<td>-4.2*</td>
<td>0.0*</td>
<td>4.2*</td>
</tr>
<tr>
<td>7 days</td>
<td></td>
<td>21.2*</td>
<td>17.0*</td>
<td>21.2*</td>
<td>-4.2*</td>
<td>0.0*</td>
<td>4.2*</td>
</tr>
<tr>
<td>14 days</td>
<td></td>
<td>21.2*</td>
<td>23.3*</td>
<td>21.2*</td>
<td>2.1*</td>
<td>0.0*</td>
<td>-2.1*</td>
</tr>
<tr>
<td>21 days</td>
<td></td>
<td>18.8*</td>
<td>14.6*</td>
<td>18.8*</td>
<td>-4.2*</td>
<td>0.0*</td>
<td>4.2*</td>
</tr>
<tr>
<td>28 days</td>
<td></td>
<td>18.8*</td>
<td>15.9*</td>
<td>19.0*</td>
<td>-2.9*</td>
<td>0.2*</td>
<td>3.1*</td>
</tr>
</tbody>
</table>

* p< 0.05: There are significant differences between two products’ remaining percentage of forces.

n.s (not significant): There are no differences between two products’ remaining percentage forces.

Figure (7) demonstrated comparison of force delivery of four elastomeric chains at each time period. Ormaer-open produced the highest initial force (400 g) while Ormaer-closed and Ormaer-open medium produced same grams of force (350 g). During the first hour, all elastomeric chains showed remarkable reduction of the force delivery and produced the same grams of force (175 g). Figure (8) demonstrated that the percentage of force delivery of four elastomeric chains during the study period. Ormco-closed maintained higher percentage of force. Ormaer-closed and Ormaer-open medium had same force decay throughout the 28 days of study period. Ormaer-open maintained less force than other product. Paired t-test was used to compare the differences of force decay between each study period of each elastomeric chains (Table 1). For Ormco-closed, there was no change in force delivery at 1-24 hr, 3-14 days and 21-28 days of study period. For Ormaer-closed, there was no change in force delivery at 24 hr - 14 days and 21-28 days of study period. For Ormaer-open, there was no change in force delivery at 1-24 hr, 3-7 days of study period. For Ormaer-open medium, there was no change in force delivery 3-14 days of study period. The results show no significant difference in force decay at Ormaer-open and Ormaer-open medium at the 21-28 days interval. Apart from above mention period, each elastomeric chain was statistically significant in force decay during the study period.

One way analysis of variance (ANOVA) was used to compare the percent reduction of force among different study period for four elastomeric chains (Table 2). The result showed that there was no significant difference in percent reduction of force between Ormaer-closed and Ormaer-open medium. During 3-7 days, all elastomeric chains had no force decay. One way analysis of variance (ANOVA) was used to compare the remaining percentage of force among different study period for four elastomeric chains (Table 3). The Bonferroni multiple comparison test was used to identify significantly difference in remaining percentage of force between different types of elastomeric chains. Although there was significant difference of remaining percentage of force between different elastomeric chains, Ormaer-closed and Ormaer-open medium elastomeric chains had no significant difference in the force delivery during the study period.

Discussion

Ormco and Ormaer clear elastomeric chains were used as the tested samples in this study because they were commercially available in Myanmar and are used regularly in Orthodontic Clinic, Department of Orthodontics, University of Dental Medicine, Yangon. Andreasen and Bishara (1970) stated that there was no statistical difference between the elastomeric chains tested under saliva at 37°C, under water at 37°C, and under...
water at room temperature. Based on this finding, 37°C water was selected as the test medium for this study to simulate mouth conditions. The study period 28 days is based on the assumption that the patient was seen by the orthodontist every three weeks and 4 – 6 weeks appointment cycle is more typical in clinical practice (Proffit, 2007). The simulated tooth movement in our study design (i.e. the reduction 0.25 mm per week of constant length) was done because about 1 mm per month may be regarded as an acceptable rate of tooth movement (Malcolm, 2000). The length of the chains used in this study (i.e., 70% to 75% of the constant distance) was selected to represent the actual retraction distance to move the canine into the space of an extracted first premolar (Poolkered, 2009). In this study, Ormco-closed in length approximately 70% to 75% of the canine retraction distance can produce the proper force (275 g) for canine retraction. But Ormaer-closed, Ormaer-open, Ormaer-open medium are higher (375 g – 400 g) than the range of optimal force for canine retraction (100 g to 350 g) suggested by Hixon et al (1969), Boester and Johnston (1974). It may be due to the use of different product brands to compare the force delivery, variations in manufacturing techniques, variations in the additives incorporated in the basic polyurethane polymer to obtain the final product, and variations in size of modules, morphological (ellipsoid or circular modules) or dimensional characteristics (presence or absence of an intermodular link) of the chains.

Regarding the pain and discomfort to the patient, Boester and Johnston (1974) found no significant difference in regard to tooth discomfort with forces ranging from 55 g to 310 g. And the short modules (Ormco-open) produced significantly higher initial force levels throughout the 1 hr to 3-day period compared to the other chains. Genovaet al., (1985) found that modules producing higher initial forces underwent less force decay than modules producing lower initial force values. In our study, the patterns were different from Genova’s study, that the greater the initial force, the grater the force decay. Perhaps it is due to different brand, batch number and design. Kuster (1986) stated that 100% extension of Ormco Power Chain II placed in vivo produced 279g and retained 52 % of initial force level after 4 weeks. In our study, Ormco-closed produced 275g at 25 % extension and retained 45.5 % of initial force level after 4 weeks. After the end of 21-day period, the remaining force for Ormaer-closed, Ormaer-open and Ormaer-open medium produced the lowest mean force levels (i.e.,lower limit for tooth movement).

Within the first 1 hour, there was a loss of 36.4% of the initial force exerted by the Ormco-closed, and 53.3% from Ormaer-closed & Ormaer-open medium, 56.2% from Ormaer-open. Therefore Ormaer-closed, Ormaer-open and Ormaer-open medium occurred 50% of force loss within 1 hour. This result agreed with the study of Andreasen and Bishara (1970), Hershey and Reynolds (1975), and Wong (1976). In all elastomeric chains, the greatest rate of force decay occurred in the first hour. However, the remaining forces exerted after one hour were still within the range for optimal tooth movement and having the same grams of force (175 g). Subsequent testing showed that during the first day, the Ormco-closed and Ormaer-open had no force degradation and others declined in a relatively linear manner. After 3 days of study, the force degradation of all elastomeric chains relatively declined in stable manner. There was no force decay during 3 to 7 days. And the Ormco-closed was stable in force delivery until 14 days and retained values well within the clinically recommended levels at the end of the 28-day period. The key to producing orthodontic tooth movement is the application of sustained force, which does not mean that the force must be absolutely continuous. It means that the force must be present for a considerable percentage of the time, certainly hours rather than minutes per day (Proffit, 2007). Within 7-21 days, Ormaer-closed, Ormaer-open, Ormaer-open medium have force decay in stable manner. And the remaining force of Ormco-closed is significantly greater from 1 hour to 28 days than other products. The decay curves for the four materials were similar in that early and rapid loss of force occurred within the first hour and then a gradual reduction in the rate of force loss was seen throughout the 28-day study period. In evaluation of all elastomeric chains in this study, the remaining force of Ormco-closed is significantly greater from 1 hour to 28 days than other products. According to statistical analysis, there was no significant difference in force delivery of Ormaer-closed and Ormaer-open medium during the study period.

In vitro studies cannot accurately simulate intraoral conditions. Nevertheless, it is still important that a clinician need to have knowledge of the force delivery system applied by elastomeric chains. Regardless of force decay in elastomeric chains, they are still a convenient, inexpensive method for providing a force delivery system with acceptable force levels for moving teeth over a 3- to 4-week period. Several factors should be considered before using elastomeric chains clinically to achieve desire orthodontic tooth movement are: (1) environmental influences, (2) the frictional force between the wire and the bracket, (3) the
optimum force for canine retraction, (4) occlusal interference, and (5) the batch histories of various manufacturers.

References


Pyogenic granuloma associated with pregnancy: A case report

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Abstract

Pyogenic granuloma is a benign, acquired, vascular growth of skin and mucous membranes which presents as a localized mass of exuberant granulation tissue that bleeds easily after minor trauma. It predominantly occurs particularly during the second and third trimesters, and tends to involute after delivery, possibly because of the vascular effects of female hormones. A case of a young female patient with tumor-like growth about 11×8 mm in upper anterior region and its management is presented herein.

Keywords: pyogenic granuloma, pregnancy, tumor

Introduction

Pyogenic granuloma (PG) is a common tumor-like growth of the oral cavity or skin that is considered to be non-neoplastic in nature (Neville et al., 2002; Vilmann et al., 1986). Hullihen’s description in 1844 was most likely the first PG reported in English literature (Hullihen, 1844), but the term “pyogenic granuloma” or “granuloma pyogenicum” was introduced by Hartzell in 1904 (Hartzell, 1904). Angelopoulos AP proposed the term “hemangiomatous granuloma” which accurately expresses the histopathologic picture (hemangioma like) and the inflammatory nature (granuloma) of oral pyogenic granuloma (Angelopoulos, 1971). Cawson et al. (1998) suggested that since the blood vessels are so numerous in oral pyogenic granuloma, alternative term for pyogenic granuloma is granuloma telangiectacticum. There are two kinds of PG namely lobular capillary hemangioma (LCH type) and non-LCH type, which differ in their histological features (Epivatianos et al., 2005).

Because of the high incidence of oral PG, especially in pregnant women, and the critical need for its proper diagnosis, management and treatment, this article will address the clinical and histopathologic features and its correlation with pregnancy.

Case report

A 28-year-old pregnant female patient in her second trimester presented to our department with a complaint of growth in the mouth involving upper anterior region which bled frequently and interfered with eating. Patient gave no relevant medical history. The patient noticed the growth one month back which was slightly smaller than the size at the time of presentation. Intra oral examination revealed a solitary growing exophytic, sessile lesion measuring 11×8 mm in size. (Fig1).
On palpation, the growth was firm, non tender, easily bleeding. Phase I therapy was performed. Haemogram of the patient was within the normal limits and the patient was taken for excisional biopsy. The lesion was excised under local anesthesia and sent for histopathological examination. The excised area covered with periodontal pack and evaluated after one week for healing, healing was satisfactory (Fig 2).

The histopathologic examination revealed stratified squamous epithelium with acanthosis and irregular downward proliferation of rete pegs. There is a focal area of ulceration with underlying granulation tissue. The immediate sub-epithelium shows dense infiltration predominantly by plasma cells, neutrophils, lymphocytes and occasional eosinophils. There is presence of multinucleated giant cells of varying size in a stroma composed of ovoid and spindle shaped fibroblasts along with the presence of proliferating, some dilated and congested blood vessels. Areas of calcification and new bone formation are seen scattered in the stroma (Fig 3). These findings were consistent with the histopathological diagnosis of pregnancy tumor.

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Fig 1: Growth in relation with upper anterior region

Fig 2: Post operative after 1 month

Fig 3: Histopathological Section showing vascular proliferation and inflammatory reaction, consistent with pyogenic granuloma (hematoxylin and eosin stain magnification ×10)
Pyogenic Granuloma of the gingiva develops in up to 5% of pregnancies (Sills et al., 1996), hence the terms "pregnancy tumor" and "granuloma gravidarum" are often used (Neville et al., 2002). The molecular mechanisms behind the development and regression of PG during pregnancy have been extensively studied. The profound endocrine upheaval of pregnancy is frequently associated with changes in the function and structure of the blood and lymph microvasculature of the skin and mucosa (Henry et al., 2006). Recent studies have revealed that sex hormones manifest a variety of biological and immunological effects. Estrogen accelerates wound healing by stimulating Nerve Growth Factor (NGF) production in macrophages, Granulocyte-Macrophage-Colony Stimulating Factor (GM-CSF) production in keratinocytes and basic Fibroblast Growth Factor (bFGF) and Transforming Growth Factor beta1 (TGF-β1) production in fibroblasts, leading to granulation tissue formation. Estrogen enhances Vascular Endothelial Growth Factor (VEGF) production in macrophages, an effect that is antagonized by androgens and which may be related to the development of PG during pregnancy. These regulatory effects of sex steroids may be manipulated as therapeutic or prophylactic measures in PG (Kanda & Watanabe, 2005).

It should be noted that the molecular mechanism for regression of pregnancy PG after parturition remains unclear. It has been proposed that, in the absence of VEGF, Angiopoietin-2 (Ang-2) causes blood vessels to regress. Yuan and Lin proposed that Tumor Necrosis Factor-α (TNF-α) upregulated the expression of Ang-2 in all endothelial cell types tested. The protein level of Ang-2 was highest in the granulomas in pregnancy, followed by those after parturition and normal gingiva. The amount of VEGF was high in the granulomas in pregnancy and almost undetectable after parturition. After parturition, there are more apoptotic cells and less Ang-2 than in pregnancy, so VEGF alone or in combination with Ang-2 could protect microvessels from apoptosis, while Ang-2 alone had no effect (Jafarzadeh et al., 2006).

In oral cavity, pyogenic granuloma shows striking predilection for gingival with interdental papilla being the most common site in 70%. The maxillary anterior area is more commonly involved. It is now universally agreed that this lesion is formed as a result of exaggerated localized connective tissue reaction to a minor injury or any underlying irritation. This irritating factor can be calculus, poor oral hygiene, nonspecific infection, overhanging restorations, cheek biting etc. Because of this irritation, the underlying fibrovascular connective tissue becomes hyperplastic and there is proliferation of granulation tissue which leads to the formation of pyogenic granuloma (Kerr, 1995). Pyogenic granuloma may occur in all ages but is predominantly seen in second decade of life in young adult females possibly because of vascular effects of female hormones (Lawoyin et al., 1997).

Clinicopathologic study conducted on gingival and alveolar hyperplastic reactive lesions observed that inflammatory gingival hyperplasia and oral pyogenic granuloma were the most common diagnosis (Peralles et al., 2006). Some authors regard pyogenic granuloma as an "INFECTIOUS" entity and reported staphylococci & botryomycosis, foreign bodies, and localization of infection in walls of blood vessel as contributing factors in the development of the lesion (Kerr, 1995). Some authors suggested that pyogenic granuloma represents an exuberant connective tissue proliferation to a known stimulus or injury like calculus or foreign material within the gingival crevice (Regezi et al., 2003). Differential diagnosis of pyogenic granuloma includes peripheral giant cell granuloma, peripheral ossifying fibroma, fibroma, peripheral odontogenic fibroma, hemangioma, conventional granulation tissue, hyperplastic gingival inflammation, Kaposi’s sarcoma, bacillary angiomatosis, angiosarcoma, and non Hodgkin’s lymphoma (Peter et al., 2000; Wood & Goaz, 1998).

Treatment of pyogenic granuloma consists of conservative surgical excision which is usually curative. There is relatively high rate of recurrence (about 15%) after simple excision (Amirchaghmaghi et al., 2008). Other conventional surgical modalities for the treatment of pyogenic granuloma reported are cryosurgery in the form of either liquid nitrogen spray or a cryoprobe. Nd: YAG, CO2 and flash lamp pulsed dye lasers have also been used for the treatment of oral pyogenic granuloma (Shenoy & Dinkar, 2006).

Conclusion

Pyogenic granuloma arises in response to various stimuli such as low grade local irritation, traumatic injury, sex hormones or certain kinds of drugs, so removal of causative irritants (plaque, calculus, foreign materials, and source of trauma) is the major line of treatment. Although this lesion is non-neoplastic growth in the oral cavity, proper diagnosis, prevention, management and treatment are very important.
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