

# Sri Lanka Dental Journal

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## EDITORIAL

**Ganananda Nanayakkara**

**Editor (SLDJ)**

The unprecedented disaster in the form of Tsunami which struck the coastal belt of Sri Lanka and eleven other countries on 26<sup>th</sup> of December left in its wake thousands dead missing and displaced. It could be remembered as one of the worst days in the 2500 years old history of our paradise island. As a result of this Tsunami in Sri Lanka over 39000 people are confirmed dead. Thousands more missing and 450000 are displaced. Two Dental surgeons lost their lives and many lost their loved ones and some had their houses and surgeries damaged.

The natural instinct of the people in Sri Lankans and the world community to help the victims was witnessed and it was truly magnificent. The Government, NGO'S and volunteers both local and foreign were seen on the field providing food, water, medicine, clothing and shelter. Aid in every form was flowing in, from all over the world for the reconstruction and rehabilitation of the marginalized.

The Sri Lanka Dental Association started a Fund, the members readily contributed to provide relief to the needy. It is heartening to note that the members of the SLDA along with the medical teams and on their own had visited these affected areas to provide dental treatment with limited resources they had. It is also encouraging

to note that one of the sister organizations has shown willingness to donate a Mobile unit to SLDA to use in these camps.

The world has witnessed one of the worst tragedies which occurred in one day and it is our hope and prayer that such a disaster would never

occur again. The natural disaster can take away everything we have in life but it cannot take away our profession, knowledge and humane qualities. So as professionals, we should recognize our moral obligations and responsibilities in helping our fellow humans by providing quality oral care to them.

## Nickel Titanium Root Canal Instruments with Greater Taper

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### *Introduction*

With the advent of nickel titanium, with its greater strength and flexibility, endodontics has gone through a massive leap forward. Dental practitioners have found that nickel titanium rotary instruments have many benefits compared to hand filing. They are considerably faster, it is easier to prepare root canals and the results are far superior.

However, the main disadvantage of the rotaries is that they are more prone to fracture. Operators changing from stainless steel hand instruments to nickel titanium rotaries tend to use the same force with them as they did with hand instruments, not realising that the hand piece is already providing all the force required.

The problem with both hand instruments and early generation rotaries is that they are designed like a screw so that they will thread into the root canal. As it becomes narrower they can bind and break. This problem of fracture is exaggerated with nickel titanium instruments with their continuous rotation compared to the alternating action used with hand instruments. A fundamental design flaw with rotary instruments is that they have constant helix angles.

In an attempt to overcome these fundamental flaws in file design as they relate to rotary instruments, various manufacturers created different methods to modify the basic file design. They blunted the cutting angles in addition to reducing the width of the cutting blades (referred to by engineers as "radial land"). This reduces

the frictional resistance of the blades with the root canal walls.

Though these designs did reduce the self-threading screw-in effect, they failed to eliminate the problem associated with the fundamental design flaw. Files continued to thread, bind and separate with these designs. In fact, they reduced the cutting efficiency of the instruments by blunting the cutting edges and actually increased the requirement for working torque, while the self-threading problem still remains. This increased demand for torque significantly increases the likelihood of breakage.

Mechanized NiTi Instrumentation has taken Endodontics by storm. What is unusual about the rapid acceptance of this method of instrumentation is how most manufacturers and lecturers minimize the need to have a number 15 file at working length before moving to this type of instrumentation. However, virtually all instruction literature first states. "Obtain a working length with a size number 15 file. Then move to the mechanized Ni-Ti Engine files."

Endodontists will tell you that the most difficult part of treatment is the location, and negotiation of small calcified or tortuous canals. It is **not** doing the bodywork of the canal. (Shaping the body may be the most "tedious" part of treatment but it certainly is not the most difficult.) Achieving apical patency in difficult canals can only be accomplished through the use of small hand instruments that allow transmission of the minute subtleties of canal system anatomy to the clinician. This "Endodontic Touch" is the essence of

skilled endodontic treatment since these tiny probing file manipulations are the “eyes” of the clinician. Once the working length has been established with a size number 15 file, the method used in shaping the body of a canal is really not that important, whether it is with hand files, reamers, rotary or sonic/ultrasonic instruments.

What has become generally recognized is that rotary motion is the most efficient way of shaping and enlarging the body of the canal; hence the popularity of rotary instruments, at the expense of the old “push pull step back filing” method. Oliet et al noted the efficiency of rotary instrumentation for canal enlargement as far back as 30 years ago. The advancements in Ni-Ti metallurgy have allowed for the creation of more flexible (albeit expensive) instruments.



**Figure 1 Shows flexibility of NiTi file**

Unfortunately, pure rotary instrumentation does little to address the problems of irregularly shaped canals, canals with an isthmus and those canals with fins. These can only be cleaned with the use of irrigation and hand files used in a deliberate effort to clean these areas. Attempting to “encompass” these areas with the rotary files would cause excessive enlargement and weakening, thinning or stripping of the root dentine. As much as we would all love a device (sonic/ultrasonic/rotary/laser/suction etc) that you could turn on and walk away from, negotiation and filing of irregularly shaped canals is still required.

Ni-Ti rotary instrumentation is best used for shaping of the body of the canal after the initial working length and apical patency has been established. Attempting to use these instruments for “path finding” or “canal negotiating” can result in catastrophic instrument breakage, usually at the most complicated part of the

canal such as the junction of joined canals, sharp bends, dilacerations and apical deltas. These fractured instruments can sometimes be removed or bypassed but at great cost in time and effort.

The basic principles of Endodontics must always be adhered to:

- (1) Establish a reliable working length (Electronically and/or via radiography).
- (2) Maintain canal patency through recapitulation with smaller files.
- (3) Establish good canal taper to allow for better irrigation and obturation of the deeper apical portions of the canals.
- (4) Maintain a “mental map” of the canal system in your head through the use of sensitive files and constant subtle tactile feedback.

The past few years have seen Endodontics move away from the traditional push-pull file motion and Step Back preparation technique to rotary motion. It is ironic that while these techniques are considered “new”, rotary motion (in the form of the “Envelope of Motion”) has been a recognized part of the Boston University Endodontic technique since its inception in the early 1960s. Better shaping in the mid-root and canal body facilitates cleaning through deeper use of irrigants. Once filled, the canal flows with the root anatomy. The small apical diameter allows for apical control of filling materials. It is this typical canal shape that is the defining characteristic of the “Boston University” technique. The cleaner, wider canals are easier to fill as well.

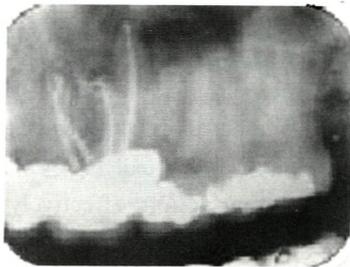
Roane’s “Balanced Force” method has also gained acceptance since its introduction in 1986. Again, instruments are used in a rotary rather than push-pull motion. Because of the way the files are used, the aggressive tip design of the standard K file required modification. These files with modified tips are known as the Flex-R.

The Crown-Down technique has also become popular because of previous problems with apical control of files. By first enlarging the orifice and body of the canal with rotary motion instruments, access to the smaller apical portions is more easily achieved. While some

## Nickel Titanium Root Canal Instruments with Greater Taper

may hail this as a revolution in endodontic instrumentation, it merely represents an acknowledgement of the principles that Schilder outlined in 1974, albeit with a slightly different method. Advanced practitioners of the Boston University technique have long understood the advantages of first reaming "short" in order to open the canal orifices to gain access to working length. Although some may label it "Crown-Down", experienced clinicians will recognize that this technique is merely an extension of the principles of proper access preparation to the canal space.

It is now possible to purchase motorized versions of these very flexible Ni-Ti instruments with differing tapers that can produce these shapes consistently.



**Figure 2 - Root canal shapes produced by NiTi instruments**

### ***The ProTaper Endodontic System (Dentsply Tulsa Dental, Tulsa, Oklahoma)***

The new Progressively Tapered (ProTaper) Nickel-Titanium rotary files represent a revolutionary progression in procedures involving root canal preparation. The ProTaper files were designed specifically to provide superior flexibility, efficiency and greater safety. The unique design feature of the files allows clinicians to create uniformly tapered shapes in difficult or significantly curved canals more consistently. The set consists of six easy-to-use files of which three are 'shaping' and three are 'finishing' instruments. These are currently available in 21mm and 25mm lengths.



**Figure 3 - ProTaper Shaping File**

### ***The Shaping Files***

The main shaping file, or Shaper X, is easy to recognize as it does not have an identification ring on its gold coloured handle. Shaper X (also known as SX) has an overall length of 19mm, effectively providing access in areas which are restricted. This file is used to optimally shape canals in shorter roots, relocate canals away from external root concavities and to produce more shape in the coronal aspects of canals of longer roots. The ability of Shaper X to brush and cut dentine on the outstroke is an advantage over all other rotary NiTi instruments. Thus after establishing a smooth, reproducible glide path over any portion of the length of the canal, Shaper X may be used to expand the preparation and maybe thought of as an ideal substitute for Gates Glidden drills.



**Figure 4 - SEM of modified guiding tip of a ProTaper file**

Shaping file no.1 and Shaping File no.2 (S1 and S2) are easy to recognize as they have purple and white identification rings on their handles. The shaping files have increasingly larger tapers over the length of their cutting blades allowing each instrument to engage, cut and prepare a specific area of the canal. Shaping file no.1 is designed to prepare the coronal one-third of a canal, whereas Shaping file no.2 enlarges and prepares the middle one-third. Although both instruments optimally prepare the coronal two-thirds of a canal, they do progressively enlarge the apical one-third.

### ***The Finishing Files***

Three finishing files named F1, F2 and F3 have yellow, red and blue identification rings on their handles. Decreasing the percentage taper over a portion of the file's cutting blades serves to improve flexibility. This feature also improves safety by reducing the potential for dangerous taper-lock. Although these instruments have been designed to optimally finish at the apical one-third, they do progressively blend and expand the shape into the middle one-third of the canal.

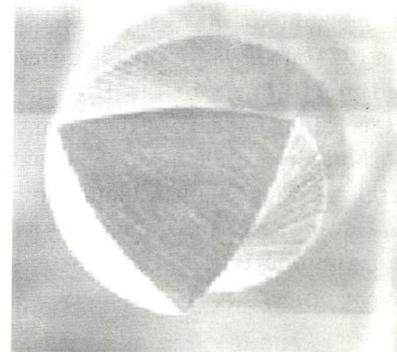
### ***Features and Benefits***

#### ***1. Multiple tapers***

A unique feature of the shaping files is their progressively tapered design that clinically serves to improve flexibility and cutting efficiency, as well as reducing the number of recapitulations needed to achieve length. The design feature of the shaping files allows each to perform its own 'crown down' work. One of the benefits of a progressively tapered shaping file is that each instrument engages a smaller zone of dentine, which reduces torsional loads, file fatigue and the potential for breakage.

#### ***2. Convex triangular cross-section***

Another unique feature of the ProTaper instruments relates to their convex triangular cross-section. This feature reduces the contact area between the blade of the file and dentine, and serves to enhance the cutting action and improve safety by decreasing the torsional load.



***Figure 5 – Scanning Electron Micrograph SEM showing the cross-section of a ProTaper file showing convex triangular design***

#### ***3. Helical angle and pitch***

ProTaper files have a continuously changing helical angle and pitch over their 14mm of cutting blades. Balancing the pitch and helical angles of an instrument optimizes its cutting action, effectively allowing the blades to auger debris out of the canal, and importantly prevents the instrument from screwing into the canal.

#### ***4. Variable tip diameters***

The three shaping files have variable D0 diameters to allow clinicians to follow the canal safely and efficiently whilst allowing each instrument's more coronal cutting blades to pre-enlarge specific zones of the canal. The finishing files have variable D0 diameters (0.20, 0.25 and 0.30 respectively) to address the obvious variations in x-sectional diameters that canals exhibit in their apical one-thirds. Generally only one finishing file is necessary to finish the apical one-third of an anatomically difficult or significantly curved canal.

#### ***5. Modified guiding tip***

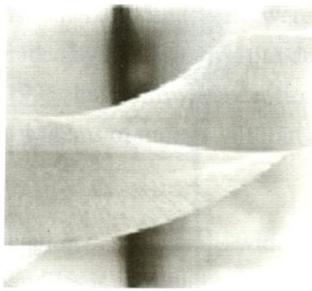
Each ProTaper file has a modified guiding tip. This design feature allows each instrument to follow the canal better and enhances its ability to find its way through soft tissue and loose debris without damaging the root canal walls.

### **6. Short handles**

ProTaper files have 12.5mm handles as compared to the standard file handle length of 15mm. This feature improves access into the posterior regions of the mouth, especially when there is a narrow inter-occlusal space.

### **7. Six instrument series**

The ProTaper system is made up of just six NiTi files, which is the fewest number of instruments as compared to all other brand lines or series of files. In anatomically difficult or significantly curved canals, only three instruments are required to produce a fully tapered canal that exhibits uniform shape over length.



**Figure 6 - SEM of active cutting surface of a ProTaper instrument**

### **Guidelines for use**

If the 'guidelines for use' are followed, the ProTaper NiTi rotary instruments will provide high performance and excellent safety. It is vital to prepare the access cavity so there is straight-line access to the orifices. Rotary instruments should only be placed in portions of the canal that have a confirmed, smooth and reproducible glide path. To achieve this, small, flexible stainless steel 0.20 tapered hand files are used to create or confirm the glide path. Also, small flexible hand files provide information regarding straightline access, cross-sectional diameter and root canal system anatomy.

To optimize the safety of the ProTaper rotary instruments, the shaping instruments should always be used in the presence of a lubricating irrigant. Pulp chambers should be flooded with sodium hypochlorite to reduce friction between the instrument and the wall of the canal.

### **Method of use**

Rotary instruments should be used passively within the canal and their use may be continued as long as they move easily in an apical direction. To optimize ProTaper safety, the 'pencil lead analogy' is used to qualify the specific recommended pressure. The desired pressure on an instrument should be equivalent to the pressure used when writing with a pencil without breaking the lead. The instruments should be 'floated like a feather' into the canal and allowed to travel apically until they meet light resistance. If any ProTaper instrument meets resistance, it should be withdrawn.

The four factors that may typically prevent a rotary file from passively moving in an apical direction are as follows:

#### **1. Insufficient canal diameter**

This will prevent a rotary NiTi instrument from passively moving deeper into the canal. This may be because the working end of a rotary file may be too big or stiff to follow the canal due to calcification. Additionally, NiTi instruments may not be able to follow a canal that abruptly curves, divides, or where walls exhibit resorptive or iatrogenic defects.

#### **2. Intra-coronal debris**

This may accumulate in a canal that previously exhibited a confirmed and reproducible glide path. To eliminate intra-canal debris, the root canal space should be flooded with copious amounts of irrigant, and recapitulated with a size 10 file to break up the debris and move it into solution.

#### **3. Intra-blade debris**

The apical movement of rotary instruments may also be limited by the accumulation of debris within the depth between the cutting blades. Intra-blade debris tends to deactivate an instrument, as it pushes the active part of the file off the wall of the canal. The instrument should thus be withdrawn and the blades cleared. The canal

should be irrigated and recapitulated with a small hand file to confirm the existence of the previously established glide path, and then it should be re-irrigated to flush out the debris.

#### ***4. Root canal anatomy***

Some systems exhibit difficult anatomical configurations that discourage or prevent the tip of a rotary instrument from passively, accurately and safely following the canal. In these instances, the canal should be irrigated and recapitulated with small hand files in order to improve the diameter of the glide path of the canal to facilitate the use of rotary instruments. With a smooth, reproducible glide path, the ProTaper rotary instruments will progressively produce a fully shaped canal that exhibits uniform taper over length.

#### ***Multiple vs. single use***

During use, the ProTaper files should be inspected for wear and its cutting blades frequently cleaned to optimize efficiency and reduce the potential for breakage. Other causes that contribute to NiTi rotary instrument breakage are the method of use and multiple use of the files. Common opinion states that all NiTi rotary instruments should be discarded after each case due to metal fatigue, loss of cutting efficiency and the greater variation in length, diameter and curvature of any given canal. When the guidelines for use are carefully followed, then the ProTaper files unique geometries offer unsurpassed safety, flexibility and efficiency.

#### ***Motors***

The ProTaper instruments may be utilized in gear reduction, high torque electric hand pieces at speeds ranging from 250-300 RPM.

### ***GT HAND FILES***

Ni-Ti instruments come as hand files as well as for use in a handpiece. These hand files demonstrate the same features as the ProFile GT rotary instruments. A predetermined funnel shape is created more efficiently- and in up to 60 percent less time- than with traditional hand-filing methods (i.e. K Flex files). A 6mm diameter, pear-shaped handle is ergonomically designed to fit the shape of your fingers when gripping the instrument.



***Figure 7 - A GT Hand file***

It is not necessary to remove excessive dentine for effective root canal preparation. GT files allow safe, standardized preparation, and should be selected to fit the case in hand. Small Root canals should be prepared with 0.06 and 0.08 taper GT files, whilst large root canals should be prepared with 0.10 GT or 0.12 Accessory GT files. The greatest challenge is un-learning habits acquired from traditional instrumentation methods. GT files should be used with light touch, and without up-down pumping motions.

Two conceptual sea changes now rolling through the specialty are responsible for this confusion.

- 1) The growing appreciation for tapered shaping objectives over the apical stop preparation.

## Nickel Titanium Root Canal Instruments with Greater Taper

- 2) The realization that we do not have to cut dentine to clean root canals.

We know that the tapered root canal shaping objective allows dramatically greater latitude in length control during shaping procedures, whereas the apical stop preparation is very unforgiving of length determination errors (Buchanan 1991).

As important, we now understand that you can clean root canals without cutting *any* dentine. Baumgartner & Mader (1987) showed that when irrigated with just NaOCl, un-instrumented canal walls were in fact cleaner than those abraded by files. In his groundbreaking paper, Lussi et al. (1995) have shown exceptional cleaning of the root canal systems of molars without *any* files being used at all.

Hand piece shaping of root canals with variably tapered nickel-titanium files is extremely simple, requiring very few steps and very few instruments. The leap to tapered root canal shapes is easy if you consider the following:

- 1) The apical diameters of root canals are more similar than different, generally in the range 0.2- 0.35 mm, so we only really need a few different tip diameters and tapers on our instruments
- 2) Tapered resistance form is not only better, but is more predictable than the stop preparation, primarily because it is forgiving of length determination errors.
- 3) Root canals are cleaned with irrigants, not by unnecessarily cutting dentine. This releases us from nearly all risks of apical laceration.

Most curved canals have small apical diameters, allowing their preparation to be carried out with the

most flexible GT files, the 0.06 or 0.08 taper files. Most canals with large apical diameters are relatively straight, allowing the introduction of the less flexible, but necessary 0.10 or 0.12 taper GT files.



***Fig. 10 - Maxillary second molar with curved canals prepared with NiTi GT files***



***Fig. 11 - Maxillary incisor with large apical diameter shaped with NiTi GT files***

***Comparison between hand instrumentation and mechanical instrumentation***

*Summary Table of NiTi Endodontic Systems*

Rotary System	Advantages	Disadvantages	Complete set
<b>Flexmaster</b>	<ul style="list-style-type: none"> <li>• Non-cutting tip</li> <li>• High resistance to fracture</li> <li>• 3 instrument system</li> </ul>	<ul style="list-style-type: none"> <li>• Can fracture in narrow canals if excess force applied</li> </ul>	<ul style="list-style-type: none"> <li>• 3 Instrument system</li> </ul>
<b>GT</b>	<ul style="list-style-type: none"> <li>• Ideal predefined canal shapes with fewer instruments, fewer procedural steps.</li> </ul>	<ul style="list-style-type: none"> <li>• Breakage of files if correct procedure is not used.</li> </ul>	<ul style="list-style-type: none"> <li>• 6 instrument system</li> </ul>
<b>Kerr3</b>	<ul style="list-style-type: none"> <li>• Cheaper compared to other systems on the market.</li> </ul>	<ul style="list-style-type: none"> <li>• Significant separation rate</li> <li>• Expensive</li> </ul>	<ul style="list-style-type: none"> <li>• 4 Instrument system</li> </ul>
<b>Profile</b>	<ul style="list-style-type: none"> <li>• Non-cutting tip</li> </ul>	<ul style="list-style-type: none"> <li>• Expensive</li> </ul>	<ul style="list-style-type: none"> <li>• 3-5 Instrument system</li> </ul>
<b>ProTaper</b>	<ul style="list-style-type: none"> <li>• Increased cutting efficiency</li> <li>• 6 instrument system</li> </ul>	<ul style="list-style-type: none"> <li>• Increased deformation rate</li> <li>• Partially active tip – produces greater amount of canal transportation &amp; other aberrations such as zips, elbows &amp; ledges</li> </ul>	<ul style="list-style-type: none"> <li>• 6 Instrument system</li> </ul>
<b>RACE</b>	<ul style="list-style-type: none"> <li>• Alternating cutting edges to allow constant cutting</li> <li>• Reduced torque</li> <li>• Electrochemical surface polishing</li> <li>• 3-5 instrument system</li> </ul>	<ul style="list-style-type: none"> <li>• Cutting tip risks transportation, perforation</li> </ul>	<ul style="list-style-type: none"> <li>• 3-5 Instrument system</li> </ul>
<b>Conventional instruments</b>	<ul style="list-style-type: none"> <li>• Greater operator control</li> </ul>	<ul style="list-style-type: none"> <li>• Less flexibility</li> <li>• Zipping</li> <li>• Harder to use</li> </ul>	<ul style="list-style-type: none"> <li>• 18 Instrument system</li> </ul>

## Nickel Titanium Root Canal Instruments with Greater Taper

Previously cleaning and shaping of root canal space has been completed with conventional stainless steel hand files, reamers and broaches, but conventional files because of their hardness and inflexibility often deviate from the original canal path. A multitude of techniques for stainless steel instrumentation have been advocated in attempts to maintain the original direction and shape of the canal. However, canal preparation with conventional instrumentation is time consuming, and tedious.

The revolutionary development in nickel titanium into files has transformed canal instrumentation. Canals are:

- Less susceptible to transportation, ledge formation and perforation. An additional advantage is that NiTi files can be used basically the same manual technique as their conventional counterparts.
- These NiTi files are effective up to ten times use and should be discarded if elastic limit exceeded or if severely bent.
- NiTi files has elastic memory so all files are manufactures by grinding the groove for their design

As well as NiTi in hand instrumentation, using the files in a mechanical way has many additional advantages:

1. Instrumentation is physically effortless.  
Ease of instrumentation is important today considering the necessity of using rubber gloves and the fact that some dentists may have developed manual dexterity problems.
2. Canals are enlarged quickly.  
Canals are not only enlarged quickly but also appear larger and flared to a greater extent than hand instrumentation of the same size.
3. Debris is removed easily.  
Canals are filled more easily as they are cleaner.
4. Canals are more uniform and smoother.  
Canal drying and filling is easier and more predictable, probably because walls are smoother and more uniform

The main disadvantages of using NiTi rotary instruments are:

1. There is less operator control. As the files are used on rotary mechanisms, the operator will have less tactile input.
2. There is a greater risk of over cutting depending on the file type.
3. Greater risk of perforation.
4. The systems themselves are expensive.
5. A degree of training is required in their use.
6. These can be quite destructive in untrained hands.

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## Porphyromonas gingivalis : A Periodontal Pathogen

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### Abstract

Bacterial aetiology of inflammatory periodontal diseases is well established. Marked differences have been observed in the microbial composition of sub-gingival plaque associated with health and disease and human periodontitis is known to be initiated and perpetuated by a small group of predominantly Gram negative - anaerobic and micro-aerophilic bacteria that colonize the sub-gingival area. The cultivation and microscopic observation of the sub-gingival flora obtained from advanced periodontal disease sites disclose a predominance of Gram negative anaerobic rods and their numbers have been shown to increase with increasing severity of periodontitis. Of these microorganisms, most evidence points to the pathogenic role for *Porphyromonas gingivalis*, which is equipped with a variety of virulence factors which enable them to colonize, survive, multiply in the oral cavity and to cause destruction of periodontal tissues of the host by direct and indirect mechanisms. This review establishes how *P.gingivalis* qualifies to be a periodontal pathogen

Bacterial aetiology of inflammatory periodontal diseases is well established. Human periodontitis is initiated and perpetuated by a small group of predominantly Gram negative - anaerobic and micro-aerophilic bacteria that colonize the sub-gingival area and marked differences

between the microbial composition of sub-gingival plaque samples obtained from healthy and diseased periodontal sites have been recorded<sup>1</sup>. The cultivation and microscopic observation of the sub-gingival flora obtained from advanced periodontal disease sites discloses a predominance of Gram negative anaerobic rods and their numbers have been shown to increase with increasing severity of periodontitis<sup>2,3,4,5</sup>. Of these microorganisms, most evidence points to the pathogenic role for *Porphyromonas gingivalis*, which is an obligately anaerobic gram-negative coccobacillus. The presence of this organism, acting either alone or as a mixed infection with other bacteria, and possibly in concert with the absence of beneficial species and certain immunological deficiencies in the host, appears to be essential for disease activity<sup>6,7</sup> and it is thought to be one of the most prominent periodontal pathogens. At the 1996 World workshop on clinical periodontics, the relevant working group concluded that most forms of human periodontitis is caused by *Porphyromonas gingivalis*, *Bacteroides Forsythus* and *Actinobacillus actinomycetemcomitans* and which are now considered as periodontal pathogens.

The objective of this manuscript is to review the evidence, which supports the role of *P. gingivalis* as a periodontal pathogen. To refresh the reader's mind with respect to the role of microorganisms in the causation of diseases in general as well as their role in the causation of periodontal diseases would be beneficial at the outset of this article.

***Specific microorganisms in the aetiology of periodontal disease.***

In general, to confirm a specific microbial aetiology of any disease condition, the Koch's postulates have to be applied. Robert Koch defined 4 classic criteria as postulates, namely,

- 1) The organism should be isolated from every patient with the disease and its distribution in the body corresponds to that of the lesions observed.
- 2) The organism must be isolated and cultured outside the body (*in vitro*) in pure culture.
- 3) The pure organism must cause disease in healthy susceptible animals.
- 4) The organism must be recovered from the inoculated animal.  
Currently these four postulates are complimented with the following.
- 5) The antibody to the organism should be detected in the patients' serum.

However, these Koch's postulates are less useful in pinpointing the microbial aetiology of mixed microbial infections such as those found in periodontal disease. Therefore in 1977 Socransky<sup>8</sup>, suggested criteria for implicating bacteria as being important in the aetiology of periodontal disease which include:

- 1) The presence of high numbers of the microorganisms in the periodontal lesion compared to either its absence or its presence in low numbers in healthy sites or non progressing sites (related to this is the identification of the microorganism as a risk factor for periodontal disease).
- 2) Elimination of microorganism from periodontal lesions should result in clinical improvement
- 3) Host immune responses to the microorganisms such as high levels of serum, salivary or gingival crevicular fluid antibody or as a cell mediated immune response.
- 4) Production of virulence factors which can be correlated with clinical disease

- 5) Appropriate animal models demonstrating tissue destruction in the presence of the microorganisms.

*P. gingivalis* has frequently been isolated from advanced periodontitis lesions<sup>9,10,11</sup> and there is strong evidence to show that *P. gingivalis* conforms to the criteria for implicating it being an important bacterium in the aetiology of periodontal disease. How *P. gingivalis* has fulfilled each of these criteria will be discussed below.

***The presence of P. gingivalis in high numbers in the periodontal disease sites and its absence or its presence in low numbers in healthy sites or non-progressing sites:***

*P. gingivalis* is usually absent in healthy gingival sulci<sup>12,13</sup> and low numbers are found in gingivitis lesions<sup>12</sup>. Higher proportions of *Bacteroides gingivalis* (now classified under genus Porphyromonas) have been found in severely inflamed periodontal sites than in healthy sites<sup>14</sup>. Increased numbers of *P. gingivalis* have also been isolated from disease active or inactive sites from 50% of all periodontitis patients with actively progressing periodontal disease<sup>15</sup>. Griffen *et al.*,<sup>16</sup> has further supported this finding by detection of *P. gingivalis* in 79% of periodontitis patients compared to the 26% for healthy individuals (Odds ratio 11.2) using a highly specific Polymerase Chain Reaction (PCR) to identify *P. gingivalis* from comprehensively collected dental plaque samples. Different percentage recovery of *P. gingivalis* in the study by Moore *et al.*,<sup>15</sup> could be attributed to the fact that a culture method was used in the latter, as opposed to the PCR method used by Griffen *et al.*<sup>16</sup>. Dahlen *et al.*,<sup>17</sup> investigated putative periodontopathogens in 'diseased' and 'non diseased' persons exhibiting poor oral hygiene. The results showed that, of seven species investigated *P. gingivalis* was the only organism to be found in greater relative proportions in test sites from diseased individuals than the matching sites with no disease in non-diseased individuals. They also found that there was a tendency for the relative proportion of *P. gingivalis* in control sites to be slightly higher in diseased individuals than in non-diseased individuals, and accordingly, no other microorganism discriminated between the two groups

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in control sites suggesting its association with periodontal disease. Conrads *et al*<sup>18</sup>, found that colonization of the periodontium by *P. gingivalis* is a very rare event in children even after using a very sensitive technique like PCR. In the same study none of the six periodontally healthy adult subjects were detected positive for *P. gingivalis* even using PCR. Mombelli *et al.*,<sup>19</sup> has reported that the presence of *P. gingivalis* was significantly associated with, location of the site, bleeding on probing, probing pocket depth and the presence of the organism in adjacent neighbouring sites. Grossi *et al.*,<sup>20</sup> related the presence of *P. gingivalis* to increased attachment loss. an association between infection with *P. gingivalis* and *B. Forsythus* and severe alveolar bone loss has also been reported by Grossi *et al.*,<sup>21</sup>. Preus *et al.*,<sup>22</sup> supported these findings when they found that there was a clear increase in prevalence of sites harboring *P. gingivalis* from health to disease with “no disease” and “gingivitis only” (5.4%) through “moderate periodontitis” (28%) to ‘advanced periodontitis’ (41.4%). It has been reported that *P. gingivalis* could be cultured from severe and moderate periodontal lesions from young adults with rapidly progressive periodontitis<sup>23</sup>. In this study the prevalence of *P. gingivalis* in these subjects was 91.7%. Further, 26.7% pockets of more than 6 mm harboured this microorganism. Prevalence of *P. gingivalis* was also found to be high in advanced periodontitis (70%) compared to adult gingivitis (10%) and paediatric gingivitis (14%)<sup>24</sup>. The above findings suggest that *P. gingivalis* is an important periodontal pathogen which conforms to the first criterion suggested by Socransky<sup>8</sup>.

High levels of *P. gingivalis* at a site has also been associated with an increased risk for alveolar bone destruction<sup>25, 26, 27, 28, 29</sup>. Interestingly, Gunsolley *et al.*,<sup>30</sup> also found that *P. gingivalis* could be considered as a risk factor and an indicator of future attachment loss during the maintenance therapy in a patient population with rapidly progressive periodontitis. According to this study the sites that were infected with this pathogen lost 0.5 - 4.5 mm of attachment during the observation period of one year.

Further, it has been found that 70% of sites were infected with *P. gingivalis* and *F. nucleatum* and attachment gain

occurred at tetracycline fibre treated sites which were initially infected with *P. gingivalis*<sup>31</sup>.

Taken together the above observations also show, increased numbers of *P. gingivalis* is associated with disease sites and the presence of *P. gingivalis*, could also indicate risk of attachment loss in the future at those sites.

### ***Elimination of microorganism ( P. gingivalis )from periodontal lesions should result in clinical improvement (criterion 2)***

Slots *et al.*,<sup>2</sup> have shown that there is rapid reduction in the counts of certain microbes in sub-gingival plaque immediately after therapy. This finding was substantiated by Socransky and Haffajee<sup>32</sup> where there was a reduction in the counts of certain bacterial species associated with disease, and the reduction was apparent even after 12 months post therapy. *P. gingivalis* was among these bacteria. The same study also found that counts of *P. gingivalis* decreased at sites which showed attachment gain and increased counts at sites which showed no attachment gain or ‘gain’ less than 1 mm in attachment. Smith *et al.*,<sup>33</sup> also have shown decreased levels of *P. gingivalis* with the clinical improvement of disease levels in patients with adult periodontitis.

### ***Host immune responses to P. gingivalis as indicated by high levels of serum, salivary or gingival crevicular fluid antibody or a cell mediated immune response (Criteria-3)***

Among the different aspects of the host response to the microbial challenge is the development of a humoral immune response to bacteria growing in the oral cavity including sub-gingival bacteria<sup>34,35</sup>. It is well established that the protective role of antibodies in a conventional extracellular infection takes four major forms: (i) opsonization, (ii) direct bactericidal action, (iii) toxin neutralization and (iv) interference with bacterial adhesion. These humoral mechanisms and the associated cellular responses are largely responsible for the curtailment of bacterial infections. These provide the rationale for preventing certain diseases such as tetanus and tuberculosis. Failure to overcome periodontopathic bacteria by host immune mechanisms

leads to initiation and progression of periodontal disease. Although the exact mechanisms leading to this failure are not understood, it may be due to impairment of innate immunity by interference with neutrophil function via blocking the migration of these cells across the epithelial barrier<sup>36</sup> or by perturbation of hosts' protective humoral immune mechanisms by causative bacteria.

Elevated levels of anti-*P. gingivalis* antibodies in the sera of patients with various forms of periodontal disease have been observed<sup>37,38</sup>. In sera of periodontal disease patients IgG isotype was found to be the major antibody found, followed by IgA and IgM<sup>37,40,41,42,43</sup>. It has also been shown that anti-*P. gingivalis* antibodies appear in the gingival crevicular fluid as well<sup>44,45,40,46</sup>. A variety of *P. gingivalis* antigens including formalin killed whole cells (FKWC)<sup>43,42,47</sup>; cell surface proteins<sup>42</sup>; fimbriae antigens<sup>41,49</sup>; whole cell sonicates, purified LPS, purified whole cell protein<sup>50,51</sup>; LPS<sup>52</sup>; trypsin-like protease<sup>53</sup>; capsular antigens<sup>54,55,56</sup>; and outer membrane proteins<sup>57</sup> and Extra cellular proteinases<sup>58</sup> etc. have been used to assess the humoral immune response mounted by a host.

There is ample evidence to demonstrate that components of the outer membrane of *P. gingivalis* bind with serum antibody from patients with periodontitis, but not with serum from healthy controls<sup>59,50</sup>. However, serum antibody responses to *P. gingivalis* outer membrane antigens in healthy subjects in the presence or absence of *P. gingivalis* in their plaque have also been reported<sup>60</sup>. Schenck<sup>61</sup> has reported significantly higher IgG and IgA levels against purified LPS in periodontitis patients when compared with healthy controls. No difference was found between AP and RPP groups in relation to IgM against LPS. However, IgM activity was significantly higher in the RPP group than the control group. There were also a positive correlation between serum IgG responses and the periodontal destruction (determined by the number of pockets with depths greater than 4mm). Ismaiel *et al.*,<sup>53</sup> have reported IgG, IgA and IgM activity against a trypsin-like protease (TLP) preparation from *P. gingivalis* W50. Results of their study showed higher IgG and IgA activity in RPP and AP subjects compared

with healthy controls. There was no difference in IgM activity found between patient groups. However, IgM activity was significantly higher in the RPP group compared with the control group. Sera in those with RPP and AP showed a wider range of response to the TLP preparation compared with healthy subjects. It has also been shown that there is a positive correlation between age and periodontal destruction with serum IgG binding<sup>53</sup>.

There are studies which investigated into qualitative differences in antibody responses to *P. gingivalis*. Variable avidity of antibodies to antigens tested has been found in sera of periodontitis patients. Generally avidity appears to be low in sera of patients which probably explains lack of protection from disease<sup>42,62</sup>. Chen *et al.*,<sup>50</sup> demonstrated, increased avidity of *P. gingivalis* antibodies in both, sero-positive and sero-negative patients after treatment, indicating boosting of the immune system with re-innoculation during subgingival instrumentation leading to affinity maturation of the antibody. Subsequent challenge by antigens lead to production of a highly effective / functional antibody response which could possibly be of a different isotype and/or subclass pattern. Further, Mooney *et al.*,<sup>63</sup> claimed that the avidity of IgM antibodies to *P. gingivalis* was lower in cases with periodontitis than that of controls, and was lowest in those cases showing attachment loss in a subsequent 3-month observation period. This suggests that either the susceptibility to periodontal disease may be associated with a poor host response.

Collectively the above findings suggest that a low avidity antibody response to *P. gingivalis*, may predict, periodontal patients at risk of further disease progression.

Host immune responses to *P. gingivalis* described above shows that a variety of antigens derived from *P. gingivalis* are capable of resulting in an immune response in the host. Those findings also confirms *P. gingivalis* to the 3<sup>rd</sup> criterion put forward by Sockransky *et al.*<sup>8</sup>, to implicate a particular microorganism as a causative agent in periodontal disease.

**Evidence for production of virulence factors by *P. gingivalis* that can be correlated with clinical disease (criterion 4)**

In establishment and progression of a disease, a pathogen must express virulence factors which are crucial to bacterium-host interactions. These play a major role in microbial colonization, host tissue destruction, evasion of host defence mechanisms, and deleterious modifications of host cells. Therefore, pathogens are selected to exhibit environmentally responsive and adaptive molecular traits, which allow adherence, entrance and replication within the host<sup>64</sup>. Intensive study of *P. gingivalis* has revealed that this bacterium is well equipped with a broad array of functional and structural features which could be considered as potential virulence factors enabling the organism to colonize and survive in the gingival sulcus/ or periodontal pocket. These virulence factors facilitate the adherence and nutrient acquisition of the organism, interact with epithelial cells, and perturb host tissue integrity and host defence mechanisms prolonging microbial onslaught on the periodontium and host derived tissue destruction<sup>65</sup>.

The major virulence factors of *P. gingivalis* are the capsular polysaccharide, fimbrial adhesins, lipopolysaccharides (LPS), outer membrane vesicles (OMV) and numerous extracellular proteolytic enzymes. Hemagglutinating activity, and toxic products of metabolism, are also recognized as important virulence factors<sup>11,66,67</sup>.

Elaborated below is how *P. gingivalis* is equipped with the above mentioned wide range of factors, which may help it enter the host, colonize, survive, and cause destruction of the host tissues.

All oral soft and hard tissues are coated with a pellicle. This pellicle is derived predominantly from molecules of salivary origin, some serum derived molecules from gingival crevicular fluid, and products related to host nutrition and epithelial cell turn over<sup>68</sup>. It is the molecules of this pellicle that provide receptors for bacterial adherence. The pellicle gradually gets colonized by early colonizers such as oral *Sterptococci*, and *Actinomyces* spp. These species are followed by late colonizers which depend on availability of binding sites for interaction on the bacteria already colonized<sup>69</sup>.

<sup>70</sup>. It is believed that *P. gingivalis* binds to other late colonizers such as *Fusobacterium nucleatum*, *Treponema denticola*, and *Bacteroides forsythus* facilitating colonization and promoting likely nutritional interrelationships and intercellular signalling mechanisms<sup>71</sup>.

*P. gingivalis* displays a variety of distinct adhesive interactions that are associated with both fimbriae and outer membrane proteins, and could be an evolutionary adaptation to the availability of a wide range of substrates<sup>65,72,11</sup>. Such multimodal adherence mechanisms may increase the likelihood of attachment as well as sustenance of the attachment by improving the avidity of binding of *P. gingivalis* to the substrates. The *fim A* protein of *P. gingivalis* has been shown to have separate and multiple binding domains that adhere to the salivary proteins, statherin and proline rich proteins (PRPs)<sup>73,74</sup> suggesting collective activity of all these domains that help establish a stable association of the fimbrillin with its salivary receptor. Further, the identification of a 48 kDa surface protein on gingival epithelial cells which interact only with fimbriated *P. gingivalis* suggests the possibility of internalization of *P. gingivalis* fimbriae to oral epithelial cells which may contribute to the pathogenesis of periodontal disease<sup>75</sup>. It has also been postulated that fimbriae-mediated effective cell adherence may be a prerequisite for the recently discovered contact dependent protein secretion pathway (type III protein secretion) in *P. gingivalis* which is somewhat dependent on Arg-x specific and Lys-x specific proteases<sup>76</sup>. This contact dependent protein secretion pathway may play a role in transducing a signal to the epithelial cells that subsequently stimulates bacterial uptake<sup>76</sup>. Major fimbriae of *P. gingivalis* induce the expression of neutrophil chemotactic factor KC in macrophages<sup>77</sup> and also directly act as a chemotactic factor for monocytes<sup>78,79</sup> suggesting its role in the local inflammatory response. Kontani *et al.*,<sup>80</sup> recently suggested that Arg- residues on extracellular matrix proteins such as fibronectin are important in fimbriae-mediated adhesion. Hemagglutinin proteins are established virulence factors for a number of bacterial species and *P. gingivalis* produces at least five hemagglutinin molecules<sup>81</sup>. When expressed on the bacterial cell surface, hemagglutinins may promote colonization by

mediating bacteria to receptors on human cells<sup>82</sup>. Since *P. gingivalis* utilizes heme for growth, binding of bacterial cells to erythrocytes may serve a nutritional function<sup>83</sup>. This fact is supported by the reported associations between hemagglutinating and proteolytic activities in *P. gingivalis*<sup>84, 85, 86</sup>. This is further substantiated by coexpression of hemagglutinin-related sequences with genes encoding proteolytic activities leading to formation of complexes of hemagglutinins and proteinases on the cell surface<sup>87</sup>.

#### **The polysaccharide capsule**

The polysaccharide capsule<sup>88</sup> of *P. gingivalis* has been suggested to provide a physico-chemical barrier against desiccation<sup>11</sup> and phagocytosis<sup>89, 67</sup>. The hydrophilic anionic properties of the polysaccharide contribute to a decrease in adherence to neutrophils and in deposition of complement components<sup>90</sup>.

#### **Lipopolysaccharide (LPS)**

*P. gingivalis* lipopolysaccharide (LPS) appears to have numerous biological properties and is composed of a large surface-associated lipid A moiety, a core polysaccharide and an extracellular polysaccharide O antigen<sup>91</sup>. *P. gingivalis* LPS can activate osteoclasts directly, and cause the release of prostaglandin E<sub>2</sub>, IL-1b and TNF- $\alpha$  from macrophages, monocytes, and fibroblasts<sup>91, 92, 93, 94, 95, 96</sup>. These compounds are potent local mediators of bone resorption and more over, can inhibit osteoblastic collagen synthesis, and induce the production of host metalloproteases that destroy connective tissue and bone<sup>97, 65</sup>. Animal experiments indicate that *P. gingivalis* LPS may induce anaphylactic shock and death in muramyl dipeptide-primed mice<sup>98</sup> and further that *P. gingivalis* LPS may be mitogenic in C3H/HeN and C3H/HeJ mice<sup>99, 100, 101</sup>. The above evidence suggests that LPS may play a role in the pathogenesis of periodontal disease.

#### ***P. gingivalis* extracellular proteases**

The primary function of proteinases secreted by asaccharolytic, *P. gingivalis*, is to provide essential

nutrients for energy and growth requirements. However, these proteinases are also involved in compromising the host tissue integrity, and perturbation of host immune mechanisms, thereby creating an environment, which is conducive to its own sustenance within the host<sup>82</sup>.

#### **Trypsin-like' proteinase (TLP) of *Porphyromonas gingivalis***

Among the virulence factors of *P. gingivalis*, proteinases have attracted considerable attention over the recent years. Proteinases have been implicated in numerous aspects of *P. gingivalis* virulence and the pathogenesis of periodontitis. These include fimbriation<sup>102</sup>, adhesion<sup>103, 104, 80</sup>, inflammation<sup>105, 106</sup> and destruction of host connective tissue and plasma proteins<sup>107, 108</sup>. As described earlier, fimbriae are important in early stages of colonization in a host and therefore could be considered as a critical virulent factor in initiating an infection. *P. gingivalis* TLP has been suggested to function as a fimbrial processing enzyme<sup>102</sup> and facilitate *P. gingivalis* adhesion by proteolytically exposing hidden receptors (cryptitopes) on the surfaces of epithelial cells and extracellular matrix<sup>109, 110, 70</sup> partially degrading host proteins and enhancing adhesion mediated binding<sup>103, 104, 80</sup>. The TLP is also known to inactivate several host proteinase inhibitors including Alpha-1-antitrypsin, Alpha2-macroglobulin<sup>111</sup>, antichymotrypsin, and cystatin C,<sup>112</sup> and several inhibitors of the coagulation pathway including antithrombin<sup>113</sup> and antiplasmin<sup>112</sup>. The TLP has been shown to cleave IgM and IgG<sup>114, 115</sup> and several components of the complement cascade, including C3 and C5, generating the biologically active anaphylatoxin, C5a,<sup>116, 117, 118</sup> as well as dysregulating the coagulation cascade, cleaving the clotting precursor fibrinogen and prolonging plasma clotting time<sup>119, 120, 106</sup>. The TLP has also been shown to impair the phagocytic and other functions of neutrophils by modifying their surface receptors as well as stimulating cytokine release from mononuclear cells<sup>121, 67, 117</sup>. Further, it has been shown that a purified preparation of a *P. gingivalis* protease with trypsin-like specificity exerted cytotoxic effects on human gingival fibroblasts by inducing apoptotic cell death<sup>122</sup>.

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Similar to other microbial proteases, the TLP appears to have a major role in inflammation and has been shown to generate kinin either directly from high- and / or low-molecular weight kininogen or indirectly via activation of the bradykinin generating cascade<sup>123</sup>. Imamura *et al.*,<sup>105</sup> have recently investigated the effect of the Rgp-A (which has TLP activity) on the bradykinin-generating pathway and demonstrated that the proteolytic activity enhanced the vascular permeability via prekallikrein activation and the release of bradykinin. In a subsequent study, Imamura *et al.*,<sup>106</sup> demonstrated that the TLP directly enhanced vascular permeability via high molecular weight kininogen cleavage to release bradykinin. Via this activation of kalikrein/ kinin pathway *P. gingivalis* seems to ensure a steady flow of nutrients to the site of infection strengthening its survival in the host environment. The data suggests that the 85% of proteolytic activities of this bacterium is mainly due to cysteine proteinases ie; enzymes which cleave protein or peptide substrates at the carboxyl end of Arginine- (Arg-X) referred to as RgpA and RgpB and Lysine- (Lys-X) residues, referred to as Kgp.

However, in addition to proteolytic activity, *P. gingivalis* can compromise a host by a variety of other mechanisms. These include; 1) production of a variety of other enzymes to degrade, host tissue components such as glycosaminoglycans, hyaluronate, chondroitin sulfate and heparin<sup>65</sup>, 2) Production of phospholipase A; capable of providing prostaglandin precursors that could stimulate prostaglandin mediated bone resorption<sup>125, 126</sup> and alkaline and acid phosphatases, which may contribute to alveolar bone resorption<sup>127</sup>; Dnase and Rnase<sup>128</sup>, 3) production of volatile sulfur compounds which are cytotoxic and can inhibit protein synthesis<sup>129</sup>, 4) and production of butyrate and propionate, which are cytotoxic for epithelial cells, fibroblasts, and lymphocytes<sup>130, 131, 129</sup>.

### Vesicles

Like other Gram -negative bacteria *P. gingivalis* can produce extracellular vesicles by out growth of the outer membrane under certain growth conditions<sup>132, 133</sup>. These vesicles contain the same LPS and array of enzymatic materials as the parent cell. They vary in size from 20-200 nm and exhibit similar proteolytic activities as seen

in whole cells<sup>133</sup>. Vesicle production increases with extracellular hemin limitation, suggesting a role for vesicles in the sequestration of essential metabolites<sup>132</sup>. *P. gingivalis* vesicles have also been shown to be strongly proteolytic, agglutinate red blood cells, can act as a bridge to mediate attachment of two non-coaggregating bacterial species<sup>134</sup>. Vesicles have also been shown to be capable of attaching themselves to serum-coated hydroxyapatite and act as receptors for oral streptococci, suggesting their contribution in plaque growth<sup>135</sup>. They have also been shown to mediate breakdown of fibronectin and native type I collagen<sup>136</sup> as well as *in vitro* cytotoxicity towards fibroblasts<sup>137</sup>. Because of their small size, vesicles may cross epithelial barriers and penetrate connective tissue threatening its integrity<sup>11</sup>. Grenier and Belanger<sup>138</sup> have also shown that extracellular vesicles of *P. gingivalis* may protect bacteria from the bactericidal effects of human serum. The presence of such vesicles on the bacterium may allow for a greater interactive surface area for both colonization by the bacterium and for local acquisition of nutrient peptides and amino acids from exposed connective tissues by acting as vehicle for toxins and various proteolytic enzymes. Membrane vesicles could also compete for antibodies and thus impede the specific antibacterial immune defence, thus extending its role as an important virulent factor in the causation of periodontal disease.

The 5<sup>th</sup> criterion described by Sockransky<sup>8</sup>, ie. capability to induce tissue destruction by *P. gingivalis* in animal models, has been discussed in the next section

### Virulence of Porphyromonas gingivalis in animal models (criteria 5)

The pathogenic potential of *P. gingivalis* has been shown in various animal models using rodents, primates, sheep and canines. Wyss and Guggenheim<sup>139</sup> employed several of the putative periodontal pathogens including *P. gingivalis* to examine their pathogenicity in a rat model. Holt and coworkers<sup>140</sup> studied the ability of *P. gingivalis* to initiate progressive periodontitis in primates. Kornman *et al.*,<sup>141</sup> have provided excellent information on the longitudinal progression of periodontal disease in a primate model. Rats have also been used extensively to study different aspects of periodontal disease. *P. gingivalis* has been

shown to be able to colonize and cause periodontal destruction in rats <sup>142</sup> indicating its virulence in this model. Evans *et al.*, <sup>143</sup> have also demonstrated the different patterns of alveolar bone loss caused by virulent and avirulent strains. Further Katz *et al.*, <sup>144</sup> investigated the ability of different *P. gingivalis* strains (ATCC33277, A7A1-28, W50 or 381) to cause abscesses and alveolar destruction in an experimental rat model and the effect of serum and salivary responses on the pathogenicity of those strains. The results of this study indicated the ability to cause abscesses does not relate directly to their periodontal pathogenicity and also indicated the importance of salivary IgA antibody responses in protection against experimental periodontal bone loss after challenge with *P. gingivalis*. Further, the rats challenged with strains A7A1-28, W50 or 381 had some or no periodontal bone loss compared to uninfected control animals. It was also found that rats challenged with ATCC 33277 had lower serum IgG and salivary IgA levels compared to animals challenged with other strains. These findings indicate that the pathogenic potential of *P. gingivalis* differs according to the strain as well as the host in whom they are colonized.

In an effort to pin point the role of specific *P. gingivalis* virulence factors in the causation of tissue destruction a diverse range of animal experiments using mutant and wild type strains of *P. gingivalis* and immunization experiments using different components of *P. gingivalis* bacterium have been carried out. Predominantly used antigens in immunization experiments were formalin/heat-killed whole cells, LPS, fimbriae, different preparations of outer membrane proteins (OM/OMPs), trypsin-like proteases, and different purified cysteine proteases such as the gingipains, prolysinases and the RgpA-Kgp proteinase-adhesin complex <sup>145</sup>. These antigens were tested on a wide range of animal models such as non-human primates, mice, and rats.

The above findings obtained from virulence and immunization experiments on animal models using *P. gingivalis* conform to 5<sup>th</sup> criterion of Socransky *et al.*,<sup>8</sup> strongly supporting the involvement of *P. gingivalis* in periodontitis.

In conclusion, *P. gingivalis* can be found in increased numbers in sites with periodontal disease and they are absent or found in very low numbers in healthy

periodontal sites. Elimination of this organism from diseased sites has resulted in improvement of disease. This organism is also very well equipped with a wide array of virulence factors, which are capable of causing periodontal breakdown, and most of them appear to bring about host immune responses. . Many research groups have shown that this organism is capable of producing similar disease conditions in animal models. Evidence presented in this paper suggests that *P. gingivalis* conforms to the criteria laid down by Socransky<sup>8</sup>. Therefore *P. gingivalis* can be considered to be a major pathogen in the causation of periodontal diseases.

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## Patterns of Dental Inpatient Service Utilization - A Pilot Study

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### *Abstract*

#### **Objective:-**

The present study aimed at assessing the patterns of inpatient service utilization at the Dental Institute (DI).

#### **Materials and Methods: -**

A total of 1419 Bed Head Tickets (BHT) in the year 2002 were analyzed for socio-demographic factors, type of referral, diagnosis, mode of treatment (whether a surgical procedure was performed as the treatment or not) and length of stay in the hospital. The diagnoses were coded according to 10<sup>th</sup> International Classification of Diseases (ICD-10) for Dentistry & Stomatology and presented confirming to an operational classification developed for the present study.

#### **Results:-**

The main cause for admissions to DI was trauma (35.9%) followed by oro-facial infections (24.8%). About 79% of patients were admitted from the Western Province and most were direct admissions. A significant male predominance was evident in admissions. Males were mostly admitted for trauma (44.8%) while females for oro-facial infections (31.4%). 42.1% of cases were managed non-surgically. According to age of inpatients, infants and children were admitted predominantly for developmental anomalies & malocclusions, adults for trauma and elderly for

malignancies. The mean duration of stay at hospital was 5.2 days and those who admitted for malignancies reported a longer duration of stay.

#### **Conclusions & Recommendations:-**

This study revealed some important perspectives of dental inpatient service utilization. Such information is needed for future planning of dental services and self-appraisal of performance. Therefore, there is a need for separate dental inpatient information system which could be developed by consensus among dental professionals based on findings of further studies in other dental inpatient care institutions.

**Key words:** dental service utilization, inpatient admission, health information systems

#### **Introduction**

Oral health care service consists of an essential component of health care provision and is closely integrated to medical infrastructure. State sector oral/dental health care services are provided as outpatient (OPD) and inpatient (Ward) services through an island-wide network of health care institutions. Consequently, information on outpatient oral care services provided by respective institutions is collected routinely and published separately in the Annual Health Bulletin<sup>1</sup>. However, at present, there is no organized system of collecting information for dental inpatient care services.

It is pertinent to collect such information as it serves as a fundamental tool in planning of oral health services and resource allocation<sup>2,3</sup>. Therefore, the aim of the present study was to assess the patterns of utilization of inpatient care services provided at the Dental Institute (DI).

### **Materials and Methods**

This descriptive study was based on the analysis of Bed Head Tickets (BHT) of patients admitted to the DI during the year 2002. Any admission, which corresponded to a BHT with a new registration number, was considered as the unit of analysis. Information pertaining to age, gender, area of residence, type of referral, diagnosis, mode of treatment (whether a surgical procedure was performed as treatment or not) and length of stay in the hospital were extracted from BHT.

Age of the patient was categorized according to the reporting format of Indoor Morbidity and Mortality in Hospitals (IMMR)<sup>5</sup>. Diagnoses were coded according to 10<sup>th</sup> International Classification of Diseases (ICD) for Dentistry & Stomatology<sup>4</sup>. However, in instances where the diagnosis was not written or treatment procedures were mentioned as diagnoses (e.g. gas extraction, osteotomy etc.), most plausible diagnoses and appropriate coding were made considering clinical histories, signs and symptoms.

Finally, all diagnoses were grouped into nine broad categories confirming to an operational oro-facial disease classification based on source of origin, as given below.

1. Trauma to oro-facial tissues: Fractures & facial lacerations
2. Oro-facial infections and its sequelae: (eg. Caries, dentoalveolar abscess, salivary gland infections etc)

3. Post-surgical complications: - post-op infections, bleeding etc.
4. Pre-malignant & malignant conditions: Oral cancers, Leucoplakia, OSMF etc.
5. Haematological conditions: Hemophilia, Etc.
6. Cysts, Tumours & Growths: Odontogenic tumours & cysts, polyps, and growths
7. Developmental anomalies: Cleft lip, cleft palate etc.
8. Malocclusions: impactions, supernumeraries, and bi-maxillary proclination etc.
9. Miscellaneous: Oro-facial pain, TMJ problems, investigations etc

The above classification was developed in two stages. In the first stage, all diagnoses were grouped according to the classification of diseases and conditions in (IMMR) reporting format. Secondly some groups were further subdivided with modifications for meaningful comparisons as described below.

Accordingly 'diseases of the digestive system' which includes diseases of oral cavity (K00-K08, K09-K14) was subdivided into three separate entities as 'oro-facial infections and its sequelae', 'pre-malignant lesions and conditions' and 'malocclusions' Similarly Injuries, Poisoning & other consequences of external causes (S00-T98), was subdivided into trauma to oro-facial tissues and Post-surgical complications. Also category of 'neoplasms' (C00-D48) was divided into two separate groups, namely 'malignant conditions' and 'cysts, tumours & growths'. 'Malignant conditions' was further modified as 'pre-malignant & malignant lesions & conditions' by the addition of 'pre-malignant lesions and conditions'. Finally, conditions that were in discernibly lower numbers compared to other categories of diagnoses, such as TMJ problems, oro facial pain; investigations etc. were grouped as 'miscellaneous'.

Data analysis was carried out using SPSS 10.0.1 software statistical package.

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### Results

Table 1 describes the pattern of admission according to operational classification developed for this study.

Table 1- Patterns of cause of admission by an operational Classification

Diagnostic category	No	%
<b>1. Trauma to oro-facial tissues</b>		
Soft tissue lacerations/trauma	44	3.1
Hard tissue-		
# Mandible	197	13.9
# Zygoma	134	9.4
Other facial #	107	7.5
# Teeth	28	2.0
<b>Total</b>	<b>510</b>	<b>35.9</b>
<b>2. Ore-facial infections &amp; its sequale</b>		
Dento-alveolar abscess (DAA)	128	9.0
Caries – (septic roots, gas ext)	92	6.5
Cellulitis/ludwig's angina	49	3.5
Other – including salivary glands infections	83	5.8
<b>Total</b>	<b>352</b>	<b>24.8</b>
<b>3. Post surgical complications – (e.g. post-op bleeding, oro-antral fistula)</b>	<b>50</b>	<b>3.5</b>
<b>4. Pre malignant &amp; malignant conditions</b>		
Pre malignant – (leucoplakia, OSMF, erosive lichen planus)	7	0.5
Malignant - squamous cell carcinoma	72	5.4
Other malignancies – sarcomas, adeno carcinomas, leukaemia	10	0.4
<b>Total</b>	<b>89</b>	<b>6.3</b>
<b>5. Haematological conditions</b>	<b>41</b>	<b>2.9</b>
<b>6. Cysts, tumours &amp; growths</b>		
Cysts:- radicular, dentigerous, eruption, mucocele	49	3.5
Odontogenic tumours :- (e.g. ameloblastoma )	28	1.9
Other growths :-polyps, epulids	17	1.2
<b>Total</b>	<b>94</b>	<b>6.6</b>
<b>7. Developmental anomalies</b>		
Cleft lip/palate	70	4.9
Other:- Cystic hygroma	8	0.6
<b>Total</b>	<b>78</b>	<b>5.5</b>
<b>8. Malocclusions – (impactions, supernumeraries, bimax proclination)</b>	<b>126</b>	<b>8.9</b>
<b>9. Miscellaneous – (e.g. oro-facial pain, TMJ problems, investigations)</b>	<b>79</b>	<b>5.6</b>
<b>Total</b>	<b>1419</b>	<b>100.0</b>

There were 1419 admissions reported for the year 2002. Of the different diagnostic categories, trauma to oro-facial tissues was the main cause for admissions (35.9%). Among this category, mandibular fractures were the highest (13.9%) followed by fractures of zygoma (9.4%). Oro-facial infections and its sequale which included dento-alveolar abscess, caries and septic roots was ranked the second most common cause (24.8%). Another, 8.9% of admissions was due to malocclusion problems.

Figure 1. Distribution of inpatient admissions by area of residence

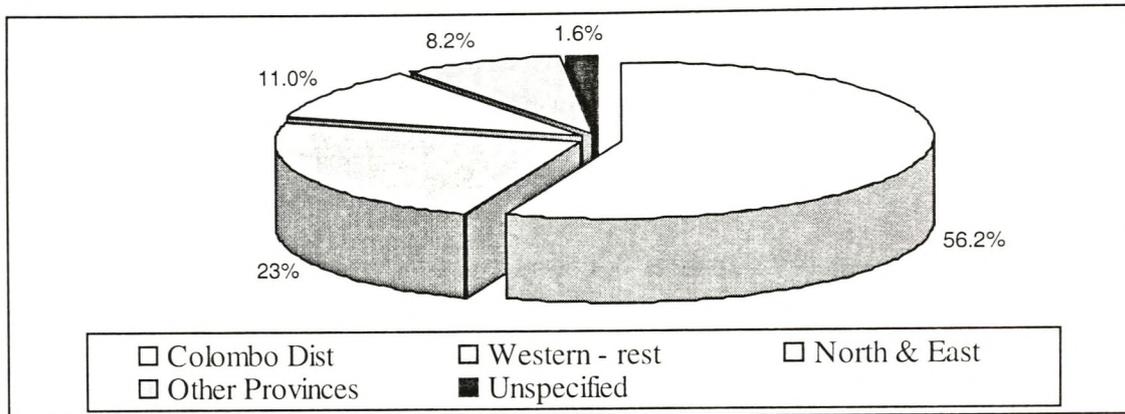
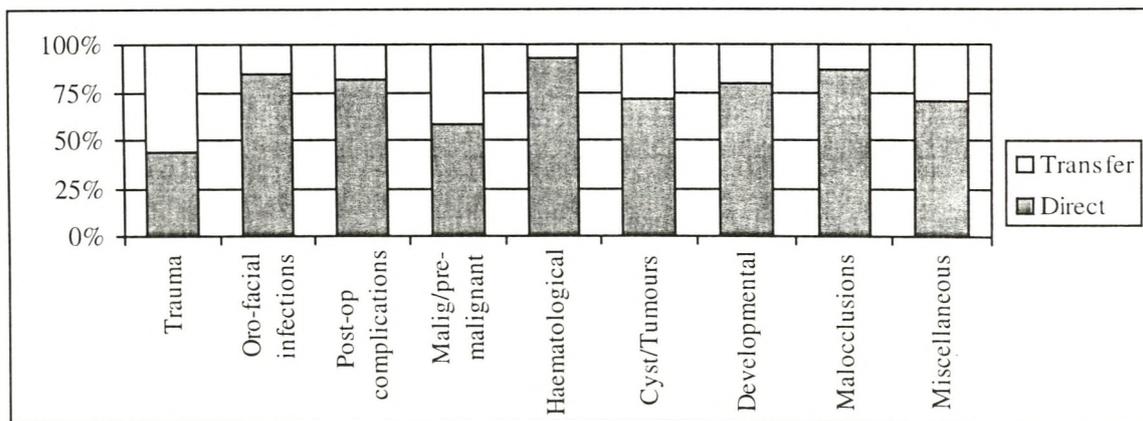


Figure 1 illustrates the distribution of inpatient admissions by area of residence. Accordingly, 56.2% of admissions were from Colombo District followed by another 23.0% from other districts of the Western Province. Admissions from North & East Provinces were higher (11%) than those from other provinces.

Figure 2. Distribution of admissions according to the cause and the type



The type of admission according to cause is illustrated in Figure 2. Direct admission denotes patients admitted through OPD, whereas other admissions, including referrals from accident services of National Hospital Colombo (NHSL) were categorized as transfers. Except for admissions related to trauma, in all other categories, the majority were direct admissions to the DI (Figure 2).

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Table 2. Distribution of cause of admission by gender

Category	Gender				Total	
	Female		Male		No	%
	No	%	No	%		
Trauma	75	16.7%	435	44.8%	510	35.9%
Oro-facial infections	141	31.4%	211	21.8%	352	24.8%
Post-op complications	19	4.2%	31	3.2%	50	3.5%
Malig/premalignant	29	6.5%	60	6.2%	89	6.3%
Haematological	16	3.6%	25	2.6%	41	2.9%
Cyst/tumours	39	8.7%	55	5.7%	94	6.6%
Developmental	27	6.0%	51	5.2%	78	5.5%
Malocclusions	65	14.5%	61	6.3%	126	8.9%
Miscellaneous	38	8.5%	41	4.2%	79	5.6%
Total	449	100.0%	970	100.0%	1419	100.0%

$\chi^2=118.7, df=8, p<0.05$

Out of 1419 admissions to the DI, majority (970) were males (Table 2). There was a significant difference in causes for admission between males and females. The most common cause for admission for males and females were trauma (44.8%) and oro-facial infections (31.4%) respectively.

Table 3 describes the distribution of cause of admissions by age group. Out of 1419 admissions, a majority (807) was in the age group of 17-49 years. Moreover, there was a substantial number of admissions from the 1-16 year old age group as well. Developmental anomalies were the main reason for admissions among infants (80%) while oro-facial infections was the main cause for admissions among children (34.7%). Admissions due to developmental conditions (14%) and malocclusions (19.1%) were also higher in children.

Trauma and malignancies were common causes for admissions among adults (17-49 years) and elderly (50-69 years & 70+ years) respectively. There was a statistically significant difference between causes of admission and age groups.

Table 3. Distribution of cause of admission by age groups

Category	Age Group (in years)					Total No (%)
	<1yrs	1-16 yrs	17-49 yrs	50-69 yrs	>70 yrs	
	No (%)	No (%)	No (%)	No (%)	No (%)	
Trauma	0 (0.0%)	59 (15.9%)	400 (49.6%)	46 (24.9%)	5 (12.5%)	510 (35.2%)
Oro-facial infections	2 (13.3%)	129 (34.7%)	162 (20.1%)	53 (28.6%)	6 (15.0%)	352 (24.8%)
Post-op complications	0 (0.0%)	9 (2.4%)	31 (3.8%)	8 (4.3%)	2 (5.0%)	50 (3.5%)
Malig/Premalignant	0 (0.0%)	2 (0.5%)	30 (3.7%)	46 (24.9%)	11 (27.5%)	89 (6.3%)
Haematological	0 (0.0%)	4 (1.1%)	29 (3.6%)	5 (2.7%)	3 (7.5%)	41 (2.9%)
Cyst/tumours	0 (0.0%)	24 (6.5%)	53 (6.6%)	12 (6.5%)	5 (12.5%)	94 (6.6%)
Developmental	11 (73.3%)	52 (14.0%)	15 (1.9%)	0 (0.0%)	0 (0.0%)	78 (5.5%)
Malocclusions	1 (6.7%)	71 (19.1%)	51 (6.3%)	3 (16%)	0 (0.0%)	126 (8.9%)
Miscellaneous	1 (6.7%)	22 (5.9%)	36 (4.5%)	12 (6.5%)	8 (20.0%)	79 (5.6%)
Total	15 (100.0%)	372 (100.0%)	807 (100.0%)	185 (100.0%)	40 (100.0%)	1419 (100.0%)

$\chi^2=588.3$ ,  $df=32$ ,  $p<0.05$

Cause of admission according to treatment modality (whether surgery was performed or not) is presented in Table 4. Forty two percent of patients admitted to the DI were managed by non-surgical means. Over 60% of patients admitted for post-operative complications, haematological conditions and in the “miscellaneous” group were treated by non-

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surgical means. Further, 33% of trauma cases were also managed non-surgically. There was a statistically significant difference between causes of admission and treatment modality.

Table 4. Distribution of cause of admission by treatment modality

Category	Surgery		No surgery		Total	
	No	%	No	%	No	%
Trauma	341	66.9%	169	33.1%	510	100.0%
Oro-facial infections	175	49.7%	177	50.3%	352	100.0%
Post-op complications	16	32.0%	34	68.0%	50	100.0%
Malig/pre-malignant	43	48.3%	46	51.7%	89	100.0%
Haematological	14	34.1%	27	65.9%	41	100.0%
Cyst/Tumours	64	68.1%	30	31.9%	94	100.0%
Developmental	52	66.7%	26	33.3%	204	100.0%
Malocclusions	92	73.0%	34	27.0%	126	100.0%
Miscellaneous	25	31.6%	54	68.4%	79	100.0%
Total	823	57.9%	596	42.1%	1419	100.0%

$\chi^2=93.7$ ,  $df=8$ ,  $p<0.05$

The average duration of stay for patients admitted to the DI by cause of admission is shown in Table 5. The mean duration of stay for patients admitted for all causes was 5.2 days. However, a longer duration of stay was observed among patients with trauma, malignancies, cysts/tumours, and haematological conditions. There was a statistically significant difference between causes of admission and duration of stay at the DI.

Table 5. Duration of stay in hospital (in days) by cause of admission

Cause of Admission	Duration of stay in hospital (in days)		
	Mean	SD	Median
Trauma	5.4	7.9	4
Oro-facial infections	4.3	3.9	3
Post-op complications	4.1	2.7	3.5
Malig/pre-malignant	9.4	11.5	5
Haematological	5.9	5.4	5
Cyst/Tumours	6.4	6.9	4.5
Developmental	4.8	4.1	4
Malocclusions	4.3	4	3
Miscellaneous	4.2	4.5	2
Admissions for all causes	5.2	6.6	4

F=6.81, P<0.05

### Discussion

Health information plays an invaluable role in any health care system. There are two fundamental applications for health information, namely, epidemiological and administrative<sup>2,3</sup>. Epidemiological application consists of describing trends and patterns of disease morbidity and mortality. Administrative application is mainly concentrated on planning, monitoring and evaluation of health services.

Gathering information on utilization of hospital inpatient services is of paramount importance as inpatient services engulf a colossal amount of resources. Therefore, it is imperative to develop and maintain a sound Health Information System for inpatient services for efficient allocation of resources by evidence based decision making<sup>6,7</sup>.

In Sri Lanka, hospital Indoor Morbidity and Mortality Return (IMMR) is the main source of information on inpatients including dental inpatient statistics<sup>1</sup>. All inpatient care institutions (other than the Maternity Homes) are required to compile IMMR by extracting information from BHT and submit quarterly to medical statistics Unit of Ministry of Health

However, there are limitations in reporting dental diseases according to IMMR format. Firstly, as dental inpatients are less in number compared to medical counterparts, there is a difficulty in observing the pattern of admissions. Secondly, the reporting format of IMMR uses broad groups of the ICD-10 classification (e.g. up to three digits) to express all disease categories. Therefore, oral/dental diseases are restricted to a few categories, thus it is not sensitive enough to capture the diversity of oral/dental diseases. For example in ICD reporting format, most oral diseases are grouped into two broad categories of K00-K08 and K09-K14. The former category (K00- K08) encompasses diseases of teeth and supporting structures such as DAA, pulpitis, peri-apical periodontitis, impacted teeth and supernumeraries etc. The latter category, (K09-K14) includes other diseases of the oral cavity such as salivary glands infections, ulcers, and pre-malignant lesions etc.<sup>4</sup>.

In such scenario, there is a need to develop a separate, concise and meaningful reporting system for oral inpatient services. The classification used in this study is such an attempt. The groupings of disease categories were based on IMMR reporting format, however certain additional categories were included for better representation of diversity of oral diseases.

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For example similar to IMMR format, all developmental anomalies were grouped into a single category, but for better representation, oro-facial infections and malocclusions were separated from the category of 'disease of the oral cavity'. Therefore, the classification derived in this study does not strictly coincide with the grouping scheme employed in IMMR format.

Moreover, miscellaneous category consisted of an array of conditions, which were insufficient in numbers to express separately. Therefore, comparison of admissions patterns observed in this study with other institutions should be interpreted cautiously, as utilization of inpatient dental services is intrinsically inter-linked with geographical factors and treatment specialties. However, due to limited numbers of reported studies on dental inpatient attendance, it is difficult to make constructive comparisons. Therefore, the discussion is mostly restricted to plausible explanation of the results.

Trauma was the main cause of inpatient admissions to the DI (Table 1). This confirms the leading cause for hospitalization which is reported in the Annual Health Bulletin (1). Further, most of them were transferred cases (Figure 2). Being situated within the NHSL and internal referral from the Accident Services could be the most plausible reason for such a pattern observed in the DI. Almost all trauma cases in Colombo district are admitted to or referred to Accident Services at NHSL. Any oro-facial injuries in those patients are always transferred to DI for management.

Oro-facial infections (namely, dento-alveolar abscess, treatment procedures such as gas extractions) constituted the second most common cause for admissions. Most of these infections could have been prevented if treatment was sought early. This probably shows that the lack awareness of patients about the importance of controlling oral disease at early stages

In this study, there was a significant male predominance in inpatient service utilization (Table 2). This is contradictory to the well-established female predominance in utilization of dental services (8-11). However, it is noteworthy that all of those studies were related to utilization of outpatient dental treatment. The most likely explanation for the above finding could be that the main cause for admissions was trauma (35.9%) and the majority of trauma cases were related to males (Tables 1&2). Generally, males are prone to traumatic

injuries due to their risk-prone life-styles. However, this tendency persisted even after exclusion of the category of traumatic injuries confirming the male predominance in utilization of in-patient dental services.

It was evident that, very high percentage of patients was admitted to the DI from the Western Province (Figure 1). However, out of all other provinces discernible portion of admissions were reported from the North and East (11%) Lack of facilities in those provinces probably attributed to frequent transfer of dental patients who requires for specialized care.

The observed age related pattern pertaining to cause of admission (Table 3), could be explained by life course perspective of oral diseases. Developmental conditions, such as cleft palate and cleft lip, are presented at birth therefore most of the cases were referred for treatment in infancy. Moreover, it is a well-established fact that dental caries and eruption problems (such as impactions, supernumeraries) are common in children. This was reflected by the higher admission rates for oro-facial infections and malocclusion problems in 1-16 year olds.

Also, in any country, economically active population is exposed to hazardous outdoor environments. Therefore, they are more prone to traumatic injuries and could be attributed to almost half (49.6%) of the admissions among 17-49 year olds. Similarly, high percentage of admissions for malignant and pre-malignant conditions among older age groups-(50-69 & 70+ years) could be substantiated by the fact that the highest burden of oral malignancies carried by this age group.

As inpatient care services provided at the DI are carried out through four Oral & Maxillo Facial (OMSF) Units, it could be expected that the modality of treatment would be surgical. Nevertheless, as revealed by the findings of this study, a substantial proportion of patients were treated by non-surgical means (Table 4). This could be due to two reasons. Firstly there is wider provision of non-surgical treatment for various orofacial diseases at different stages. For example, some diseases like Facial pain, TMJ problems, and facial fractures without displacement, could be treated successfully by non-surgical means. Secondly, patients with conditions which require surgical procedures, like malignancies and some oro-facial infections, were managed initially by non-surgical means (drug therapy & some investigations), and were discharged later by giving

subsequent appointments for surgeries. Such patients were also considered as those who were treated non-surgically.

The duration of stay at a hospital varies with the type of the diseases and complexity of the treatment provided. Generally, patients admitted for chronic diseases such as mental disorders, and patients who had undergone extensive surgical procedures for conditions like cancers, reported significantly longer durations of stay than others. The same pattern was also reflected by the findings of the present study as well. Those who have undergone extensive surgical procedures (patients who had undergone for surgery for malignant conditions) and were admitted for haematological conditions (need prolong drug therapy in order to establish normal clotting mechanisms), reported longer duration of stay than others (Table 5).

#### **Conclusions and Recommendations**

This pilot study revealed some important aspects of dental inpatient service utilization. Oro-facial trauma was the main cause of admission followed by oro-facial infections. Except for trauma cases, most patients were admitted directly. Moreover, a significant male preponderance was evident in relation to dental inpatient service utilization. A majority of admissions were reported from western province. With regard to the age of admission, infants and children were mostly admitted for oro-facial anomalies and infections, adults for trauma, and elderly for oral malignancies. It is also observed that, a substantial proportion of patients were treated by non-surgical means. Considering the hospital bed utilization pattern, patients who were admitted for malignancies had a longer stay than others.

Information on utilization of dental in-patient services is pivotal to the future planning and self-appraisal of performance. Therefore, it is pertinent to formulate an organized Health Information System for dental inpatient services provided. The problems in relation to reporting of oral/dental inpatient statistics through currently employed ICD/IMMR system could be rectified by development of a separate, concise yet meaningful reporting format for dental inpatient services.

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## **The Prognostic Significance of the Sub-Epithelial Endothelial Cell Density in Oral Leukoplakia**

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### **Summary**

The endothelial cell density in the immediate sub epithelial connective tissue of 10 leukoplakias that eventually transformed into squamous cell carcinomas and 12 leukoplakias that did not change for a period of 5 years were studied. Endothelial cell were stained on paraffin embedded tissue using an antibody against the factor VIII related antigen as the immuno probe. Number of positively stained endothelial cells in 3 randomly selected fields of known square area was counted. Results showed a higher endothelial cell density (881.7mm<sup>2</sup>) in those transformed into carcinomas compared to those that did not change (592.89mm<sup>2</sup>). Findings in our study indicates that the endothelial cell density in the connective tissue immediately below the epithelium may have a value in predicting the neoplastic transformation potential of oral leukoplakia.

**Key words:** Endothelial Cell, Leukoplakia, Neoplastic transformation

### **Introduction**

Oro pharyngeal carcinoma accounts for 16.8% of all cancers in Sri Lankan patients<sup>1</sup>. It is well known that most of these carcinomas progress from a clinically recognizable pre-malignant lesion. Premalignant status of Oral Leukoplakia is well established<sup>2-4</sup>. Although about 6% of leukoplakias eventually transform into squamous cell carcinoma, the remainder would stay unchanged or even revert back to normal epithelium if the causative agents are effectively removed<sup>4</sup>. Early recognition of those Oral Leukoplakias that would eventually undergo malignant transformation has still been proven to be difficult. Although histopathological

grading of dysplasia has a positive correlation to the risk of malignant transformation, even the least dysplastic lesions can undergo malignant transformation fairly rapidly whereas lesions with moderate and severe dysplasia could remain unchanged for a longer period of time<sup>5</sup>. Value of molecular markers such as p53 and Cytokeratin in predicting prognosis of pre-malignant lesions is questionable as recent literature shows contradictory results<sup>6</sup>.

Literature suggests that tumour induced angiogenesis is an important step in the evolution of the malignant tumour<sup>7</sup>. Many workers have described the association

between growing solid malignant tumours and new vessel growth<sup>8-9</sup>. Tumour cells have been reported to induce proliferation of endothelial cell<sup>10</sup>. As such, it is reasonable to hypothesize that the leukoplakias that would subsequently transform into malignant lesions (pre-neoplastic leukoplakia) would also have the inborn ability induce endothelial cell proliferation. Primary objective of the present study is therefore to find out whether the endothelial cell density in the sub epithelial connective tissues of oral leukoplakia could be used to predict the risk of malignant transformation.

### **Materials and Methods**

Endothelial cell density of 10 leukoplakias that eventually transformed into squamous cell carcinoma and 12 leukoplakias that did not change for a period of 5 years were studied. Histopathological diagnoses of all 22 cases were reconfirmed using newly prepared himatoxylin and eosin stained sections. Patients were all between 50 and 74 years of age and the sex distribution was compatible between the two groups.

Immunohistochemical staining of the endothelial cells were carried out on paraffin sections using a monoclonal antibody (Code No. 1809 Dako) against the Factor VIII related Antigen (FVIII<sub>Ag</sub>). Paraffin sections were mounted on 3 aminopropyl trihydroxy silane (APS) coated slides. They were then dewaxed, rehydrated, blocked for endogenous peroxidase and pretreated with trypsin for protein digestion. Sections were then incubated with the primary antibody (FVIII<sub>Ag</sub>) followed by the secondary antibody labeled with HRP. The colour was developed subsequently with DAB.

The endothelial cell density was assessed without the knowledge of the status of the leukoplakia i.e. whether the lesion was from a preneoplastic leukoplakia or from a leukoplakia that did not change. Endothelial cells in 3 randomly selected fields (each measuring 0.0625mm<sup>2</sup>) were counted in each section using a microscopic graticule with 0.5mm grid (Graticules Pyser HGI Ltd UK). Only those cells stained positively for FVIII<sub>Ag</sub> (Figure 1) and contained nuclei were counted. Sections were read by one investigator and a sample representation was then re-read by another. Results were concordant with less than 10% difference between repeated

readings. Density of the cells was expressed as number of cells per square millimeter (mm<sup>2</sup>). Higher the density of endothelial cells, the vascularity was considered greater.

### **Results**

Age and the sex distribution of the 2 groups were compatible and showed no significant difference. The median age of the patients in the transformed group was 60 years; the non-transformed group 58 years. There were 9 male and one female in the transformed group and 9 males and 3 females in the non-transformed group.

### **Histopathology**

Out of the 10 leukoplakias that eventually transformed into squamous cell carcinomas, 2 were mild dysplasias, 6 were moderately dysplastic and the remaining 2 were severely dysplastic. Leukoplakias that did not undergo malignant changes consisted of one case of keratosis without dysplasia, 7 cases of mild dysplasias and 2 cases of moderate dysplasias (Figure 2).

### **Endothelial cell density**

Endothelial cell density of the two study groups are shown in Figure 3. Results showed a higher endothelial cell density of those leukoplakias that subsequently transformed into carcinomas, compared to those that did not undergo malignant transformation (592.89mm<sup>2</sup>). Student t-test was carried out and the difference in the endothelial cell density was statistically significant at 0.05 level (p=0.03).

### **Discussion**

Higher endothelial cell density in oral preneoplastic leukoplakias in the present study indicate that there is an increase in the vascularity in the immediate sub epithelial connective tissues, compared to leukoplakias that were stable for a period more than 5 years. Angeogenic assay has been reported by Brem et al.<sup>11</sup> to have a value in distinguishing preneoplastic breast lesions from the others even before morphological signs of atypia and invasion appear. According to Brem's study about 30% of hyperplastic human breast

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epithelium acquires the ability to elicit angiogenesis. Indeed, it has also been reported that the frequency of neoplastic transformation was higher in those hyperplastic lesions that demonstrated positive angiogenic response. Similar findings in the present study also suggest a greater angiogenic potential of pre-neoplastic oral leukoplakia.

It has also been found that the pre-invasive breast lesions are less vascular and the onset of angiogenesis is seen in the phase of rapid growth<sup>11</sup>. In case of oral preneoplastic leukoplakias, it is not known at what point of time in the natural history, the increase of the vascularity takes place. However, there is strong evidence in favor of the hypothesis that a neoplastic state is acquired stepwise<sup>12,13</sup>. High endothelial cell density in the preneoplastic leukoplakias probably indicates their ingrained power of stimulating angiogenesis.

Number of cases in our study is small. Difficulty in finding cases with follow-up biopsies with subsequent malignant transformation should be appreciated. Other researchers who have carried out similar work too have had difficulties in finding follow-up biopsies and therefore, worked on smaller numbers. Findings in our study indicate that the endothelial cell density in the connective tissue immediately below the epithelium may have a value in predicting the neoplastic transformation potential of oral leukoplakia.

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## **Evaluation of the Quality of Dental Restorations in Sri Lanka**

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### **Introduction**

Restorative dentistry has been one of the corner stones of dental treatment from time immemorial. However recent decades have been marked by a revolutionary shift in the philosophy of Restorative dentistry from the mechanical repair of decayed teeth to a biological approach in the control of dental caries as an oral infection. These changes have been accompanied by concerns about the quality of dental restorations. Such concerns have been influenced by longstanding evidence that a third of all restorations are failures on one or more counts<sup>1</sup>, with two thirds of all restorative treatment involving the replacement of existing restorations<sup>2</sup>. Extensive evaluations in Scotland in the 1980's revealed the unsatisfactory nature of restorative dentistry as practiced, from several different perspectives<sup>3</sup>. In the UK public anxiety triggered by such revelations resulted in an official government inquiry which concluded that there was a significant and unacceptable amount of unnecessary restorative treatment in the British NHS. Far more recently the need to ascertain and ensure the quality of restorative care is also driven by the current emphasis on clinical audit, clinical governance, evidence based dentistry and the need for the economic rationalisation of dental treatment and good management of health care institutions amidst rising health care costs.

Many of the influences that have spurred an interest in the quality of restorative care in economically advanced countries are equally if not more relevant to developing countries. It is plausible that in Third World countries like Sri Lanka the constraints created by the socio cultural, professional and economic milieu in which dental treatment is provided might make it even harder to sustain the quality of dental care.. Therefore the evaluation of the quality of restorative dentistry in such

a setting probably assumes equal if not greater importance.

Sri Lanka has a population of approximately 1520 dentists the majority of whom ( about 60 %) are employed in State sector dental clinics. The proportion in full time General Dental Practice is estimated to be only about 11%. However a large majority of dentists in the State sector are known to do part time private practice. Private dentistry is expected to grow in a market oriented economy where there is an increasing paucity of vacancies in the public sector. However for the present hospital dental clinics comprise the dominant locus of oral health care delivery in Sri Lanka.

The objective of the present study was to evaluate the quality of dental restorations found in the teeth of patients reporting for treatment to State sector hospital dental clinics.

### ***Selection of the Sample:***

Sample selection was carried out using the technique of multi stage sampling. For sampling purposes the nine provinces of Sri Lanka were considered as natural strata. Of the nine provinces two (Northern and Eastern ) were excluded from the study due to security considerations. From the remaining seven provinces three were selected using simple random sampling, without replacement. The selected provinces were the Southern, Central and Western provinces.

In each province State run dental clinics are situated in three categories of hospitals which include the large Teaching and Provincial hospitals, the intermediate Base hospitals and the smaller district hospitals. From the total of 79 clinics situated in these hospitals a sample of 16 clinics were drawn using probability proportional

to the size. Table 1 one shows the number of clinics in each type of hospital in the relevant provinces with the number of clinics selected in paranthesis.

**Table 1**

Province	Teaching and Provincial Hospitals	Base Hospitals	District Hospitals
Western	9(2)	5(1)	15(3)
Central	2(2)	3(1)	27(3)
Southern	3(1)	1(1)	14(2)

Subjects having dental restorations were selected from the outdoor patients register of the respective clinic by simple random sampling without replacement. In this way a total of 658 subjects were included in the final sample. The subjects were first interviewed to obtain basic information about their restorations including when they were placed, by whom, and where. Information was also obtained about the past dental history oral hygiene habits and diet of the subjects. On average 5-7 subjects were examined at each visit to the respective clinic and the average time spent on each patient was around 20 minutes. This was followed by a clinical examination of the oral cavity using a mouth mirror sickle shaped probe and the CPITN probe and this included a detailed assessment of the quality of restorations. A total of 1884 restorations were available for scrutiny in the sample of 658 subjects.

The restorations were surveyed in terms of the five defined morphological characteristics contained in the California Dental Association (CDA) quality evaluation system for the assessment of dental restorations namely anatomical form, surface quality, marginal integrity, colour and the condition of the restored tooth and supporting tissues<sup>4</sup>. In conformity with this system the restorations were rated for thirteen features pertaining to anatomical form. In each case a judgment was made whether the form was satisfactory or unsatisfactory and if the latter whether or not the defect was remediable. Surface quality of the restorations was

examined for smoothness, roughness, pitting, wear facets, dentine or base exposure and fracture. The marginal integrity was assessed by looking for crevices, fracture, mobile or missing restorations. Colour was assessed in terms of the colour of the tooth, margin and restoration.. Finally the restored tooth and supporting tissues were also examined to determine the presence and extent of fifteen additional features including (amongst others) fluorosis, opacities, attrition, abrasion, and erosion.

All subjects were examined by a single examiner . Before the commencement of the main survey pilot studies of the questionnaire based and clinical examinations were carried out on 25 subjects. Diagnostic consistency was assessed by recalling the first 60 subjects examined in the main survey of whom 27 ( 45%) reported for a duplicate examination. They had a total of 72 restorations which were available for re-examination

Data analysis was carried out on computers using Statistical Analysis System (SAS) software.

### **Results :**

A total of 658 subjects were examined. 66.9% were females and 33.1% were males. 45.6% of the subjects were from the Southern province followed by 31.9% from the Western and 22% from the Central provinces. 97.7 % of the subjects were between 10 and 50 years of

## Evaluation of the Quality of Dental Restorations in Sri Lanka

age with 53.6 % in the 31-50 age group.. The ethnic distribution of the study population was 85.4% Sinhala, 3.2% Tamil and 11.4% Muslim. 21.1% and 78.9%. of the subjects were from the urban and rural sectors respectively.

The duplicate examinations on 72 restorations showed no significant differences in the number of defects detected by the examiner at the first and second examination, irrespective of the morphological characteristic scored (  $P > 0.05$ ).

The sample of 658 subjects had a total of 1884 restorations, 85.9% of which were Amalgam restorations. They had a mean DMF of  $14.4 \pm 7.2$  which

included a mean filled component of  $1.4 \pm 7.2$ . Roughly half the subjects had one to three restorations each while 23% had four or five restorations .About 21% carried seven or more restorations. 74% of these restorations had been placed by a qualified dentist while 16.5 % had been placed by school dental therapists and 9% by an unqualified practitioner. The proportion of restorations placed in State hospital clinics, private clinics, and school dental clinics were 38.3 %, 44.1 % and 17.6 % respectively.

Of the 1884 restorations evaluated 1001 (53.1%) were considered to be satisfactory on all counts in terms of the defined criteria. Conversely 883 (46.9%) of the

restorations were deemed to be unsatisfactory in one or more respects (Table 1).

**Table 1 - Distribution of the quality of restorations in the study population**

Number of subjects	658
Number of restoration	1884
Satisfactory restorations	1001 (53.9%)
Unsatisfactory restorations	883 (46.1%)

Of 1884 restoration 1620 were Amalgam fillings and 264 tooth-coloured restorations. Table 2 shows the quality of restorations depending on the type of filling material used and the tendency for tooth coloured restorations to have twice as many unsatisfactory restorations as amalgam restorations (Table 2).

**Table 2 - Distribution of the quality of amalgam and tooth-coloured restorations**

Quality	Amalgam (n = 1620)	Tooth-coloured (n = 264)
Satisfactory	957 (59.1%)	44 (16.7%)
Unsatisfactory	663 (40.9%)	220 (83.3%)
Total	1620	264

Table 3 shows the distribution of the 663 unsatisfactory amalgam and 220 tooth coloured restorations according to the type of deficiency. It can be seen that around 90% of teeth with unsatisfactory amalgam restorations were defective in marginal integrity and a similar proportion had secondary caries.

In the case of the unsatisfactory tooth coloured restorations unsatisfactory colour was almost universal while a little over a third had defective marginal integrity and nearly half the relevant teeth had secondary caries ( Table 3)

**Table 3 - Distribution of unsatisfactory restorations by unsatisfactory characteristics**

Characteristics		Amalgam	Tooth coloured
Anatomical form	484	(73.0%)	44 (20%)
Marginal integrity	584	(88.1%)	81 (36.8%)
Surface	219	(33.0%)	25 (11.4%)
Secondary caries	606	(91.4%)	107 (48.6%)
Colour			214 (97.3%)

Table 4 shows the distribution of unsatisfactory restorations in terms of the number of faults. It can be seen that overall the majority of restorations ( 30.7 %) had three faults. About 66 % of unsatisfactory amalgam restorations had two or three faults compared to the same proportion of unsatisfactory tooth coloured restorations which were seen to have one or two faults (Table 4).

**Table 4 – Distribution of unsatisfactory restorations by the number of unsatisfactory characteristics**

Number of faults	Amalgam (n = 663 )	Coloured ( n = 220 )	All (n = 883)
One	81 ( 12.2 %)	101 (46.0)	182 (20.6)
Two	144 (21.7%)	44 (20.0)	188 (21.3)
Three	228 (34.4%)	43 (19.5)	271 (30.7)
Four	210 (31.7%)	7 ( 3.1)	217 (24.6)
Five		25 (11.4)	25 ( 2.8)

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Table 5 shows the frequency of specific defective characteristics depending on the number of faults in the case of amalgam restorations. It can be seen that lack of marginal integrity and secondary caries tended to be the dominant shortcomings irrespective of the number of faults .

**Table 5**

Single	M	37	45.7%
	Sc	44	54.3%
Two	A+M	14	9.7%
	A+Sc	35	24.3%
	M+Sc	95	66.0%
Three	A+M+Sc	219	96.0%
	Others	9	3.9%
Four	A+M+Sc+S	210	100%

\*\* Code:     A     =     Anatomical form  
               M     =     Marginal integrity  
               S     =     Surface texture  
               Sc    =     Secondary caries

Finally Table 6 shows the frequency of unsatisfactory restorations in relation to the positioning of the margin of the restoration. It can be seen that irrespective of the material used class of restoration or restoration size, the frequency of unsatisfactory restorations was significantly higher where the margins were around pits and fissures compared to smooth surfaces

**Table 6 :Frequency of Unsatisfactory Restorations Depending on Positioning of Margin**

Restoration Type	No. Unsatisfactory	n	No. Unsatisfactory	N
	Margin on smooth surface		Margin at pit/fissure )	
Amalgam	93 (9.5%)	984	570(89.7%)	636
Tooth colour	173 (81.2%)	213	47(92.2%)	51
Class 1	39 (5.2%)	755	380(83.9%)	441
Class 2	44(35.5%)	124	179(97.3)	184
Class 3	55(71.4%)	77	37(100%)	37
Size 1	46(9.4%)	491	31(33.7%)	92
Size 2	97(21.9%)	442	152(97.4%)	156
Size 3	79(56.4%)	140	255(100%)	255

### **Discussion:**

The present study was a first attempt to investigate the quality of restorations placed by Sri Lankan dentists and other dental operatives working under the typical constraints of a third world country. For this purpose the sample of 658 subjects was drawn entirely from patients attending State run dental clinics. However the 1884 restorations carried by the subjects had been placed in a variety of practice settings some in hospital clinics where there are frequent shortages and conditions are fairly basic, some in relatively sophisticated private clinics, and others in school dental clinics where working conditions may verge on the spartan. Therefore unlike the many reports of the quality of restorative dentistry in the British National Health Service which emerged in the 1980's, and other reports pertaining to general practice, the present results do not represent the restorative standards in a homogeneous work environment<sup>5</sup>.

The Sri Lankan sample contained 85.9 % amalgam restorations - seven times the number of tooth coloured restorations. This contrasts with trends in USA, Australia and Scandinavia where amalgam use has been declining with smaller decreases in the UK<sup>6</sup>. A Norwegian study of nearly 25, 000 restorations placed by 243 dentists in general practice found that 32% of restorations were amalgams and just over 40% composites with about 25% glass Ionomer<sup>7</sup>. (Mjor 1999). The high proportion of amalgam restorations in Sri Lanka probably reflects a tendency for dentists in a developing country to persist with older technologies especially given the high cost of tooth coloured restorations.

The finding that overall 46.1 % of restorations were faulty is worse than the 33% failure rate reported several years ago by Elderton in the UK<sup>8</sup>. However caution must be exercised in making such comparisons as the observed differences might reflect different standards of evaluation and also a different mix of restorative materials where modern samples of restorations would contain a larger proportion of weight bearing tooth coloured restorations compared to the dominance of amalgam in a previous era.

In the present study the frequency of defective tooth coloured restorations (83.3%) was twice that of amalgam restorations. This is more or less consistent with

previous reports that posterior composites have half the longevity of amalgams<sup>9</sup>. It is well known that restoration failure is caused by both dentist and patient related factors. In the Sri Lankan situation it is possible that the extremely high frequency of faults in tooth coloured restorations might be due to a failure on the part of dental personnel to meet the meticulous technical standards that are a sine qua non for the success of such restorations. Moreover the present study did not explore the age of the restorations which is an important factor in the development of defects. A recent review<sup>10</sup> concluded that it is necessary to distinguish between the factors that cause early failure and those that are responsible for failure several years later and also reported that amalgam restorations had an annual failure rate of 3.0%. Nevertheless taken as a whole the finding that 46.1 % of the restorations were defective is a disappointing reflection of the quality of restorative dentistry in this sample. Moreover in many cases the restorations failed on multiple counts. 66% of failed amalgam restorations had 3 to 4 defects while 54% of failed tooth coloured restorations had at 2 or more defects.

The trend ( Table 5) for marginal integrity and secondary caries to be the commonest defects is not surprising. They are related problems since marginal leakage generally predisposes to secondary caries. Moreover a wide range of dentist as well as patient related shortcomings related to the placement and maintenance of a restoration can contribute to marginal leakage. For example, Even in the case of tooth coloured restorations nearly half the failed restorations had secondary caries while little over a third had marginal leakage. However the finding that colour deficiencies were almost a universal feature of unsatisfactory tooth coloured restorations was to be expected considering the kind of the material used in such restorations. A significant finding ( Table 6) was the large increase in defects observed where the restoration margin was located adjacent to pits and fissures rather than on smooth surfaces. With the placement of more minimum restorations on occlusal surfaces nowadays there may be a need to educate practitioners about the need to seal the margins of such restorations with fissure sealants.

The intention of the present paper is to present an overall picture of dental restoration quality in Sri Lanka from a community perspective taking into account

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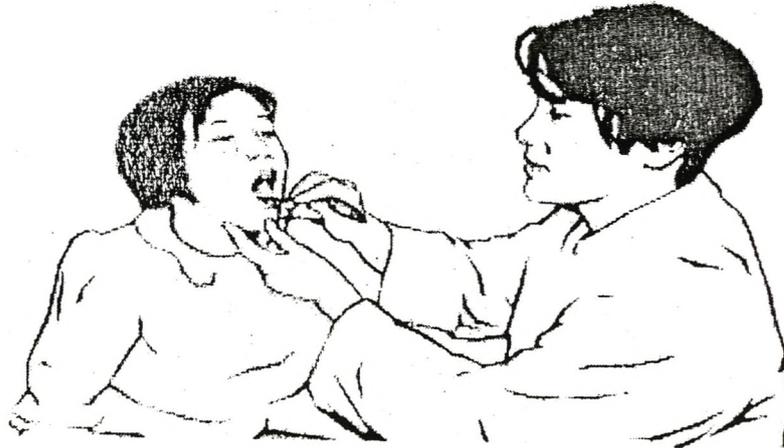
fillings people carry in their mouths irrespective of the type of operator who placed them. It was found that nearly 10% of the fillings discovered in the present random sample of patients attending State dental clinics had been placed by unqualified personnel. A comparison of the quality of restorations placed by different types of dental personnel will be reported in a future paper. However while 10% is probably too small a number to have a significant influence on the overall trends reported nevertheless the fact that patients had recourse to an unqualified practitioner for one in ten restorations reflects the misplaced confidence that many people still have in such practitioners.

The high prevalence of defective restorations is one of the perennial limitations of restorative dentistry and the present study has hinted that such deficiencies might be even more pronounced in a Third World Country like Sri Lanka. At the present time in Sri Lanka many graduating dentists face an insecure future with the declining availability of jobs in the state sector. Many of them lack both the confidence and the financial resources to start up in private practice where they may face inadequate earnings owing to the inability of patients to afford the high cost of treatment. Moreover the competition for jobs in the state sector and for patients in the private sector is set to become more acute as dentist to population ratios continue to decline with many more dentists graduating than retiring for the foreseeable future. In such a practice environment there is increasing potential for sub standard restorative dentistry with Zarb's (1991) 'hungry dentist' tending to carry out unnecessary treatment amidst evidence that the half life of restorations decreases when dentist' earnings decline.<sup>11</sup> In this climate the results highlight the need for a combination of educational, system related and political interventions that would provide an atmosphere favouring a better quality of restorative dentistry. These may involve the strengthening of continuing education for all dental personnel, setting standards of excellence for clinical practice within systems of clinical governance and quality assurance as in countries like the United Kingdom, better working conditions incorporating modern technologies especially in State dental clinics, and socio political and legal interventions to deter unqualified dental practitioners. The results of the present study may be

seen as a preliminary evidence base that would stimulate such policy initiatives.

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## CASE REPORT

# Sebaceous Adenoma of the Parotid Gland with Multiple Recurrences.

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### *Introduction*

Sebaceous adenoma is a benign, encapsulated epithelial tumour composed of cells showing focal sebaceous differentiation.<sup>1</sup> In spite of the frequent occurrence of sebaceous glands in salivary tissues, primary sebaceous tumours are exceptionally rare comprising less than 0.2% of all benign and malignant salivary gland tumours.<sup>1</sup> Sebaceous adenomas represent about 0.7% of all adenomas of the major salivary glands, parotid gland being the commonest site.<sup>1</sup> Diagnosis of the lesion is purely by incisional biopsy and microscopic examination. Treatment consists of complete excision of the tumour and recurrence is relatively rare. This article reports a case of a sebaceous adenoma of the parotid gland with multiple recurrences in a 40 year old female. There are no other reported cases of multiple recurring SA in the medical literature.

### Case report

A 40 year old female presented with the complaint of a discharging lesion in the left side pre auricular region. It had presented initially as a slowly enlarging lump of

1 month duration, which has got ruptured eventually and started discharging. There was a history of lumps at the same site 4 times within the past 12 years. The first incidence was in 1991 when the patient had presented with a swelling in the left side parotid region. On examination, it had been a well circumscribed, painless, rubbery hard swelling measuring 4cmx4cm. Although enucleated, it had recurred in 5 months presenting as a smaller lesion at the same site and with the same clinical picture as the previous occasion. It had been diagnosed as sebaceous cyst by aspiration biopsy and later enucleated.

However, in 1993 also there was another recurrence. This time it was diagnosed as adenomatoid sebaceous hyperplasia and therefore surgically excised. Seven years later, the patient had again presented with a swelling in the left side parotid region, which was diagnosed as sebaceous adenoma by incisional biopsy and was surgically excised with a tumour margin of 1cm. After that, patient was tumour free for nearly 3 years until she presented recently with a ruptured and discharging lesion.

On examination of the present lesion, there was a discharging sinus in the left side parotid region and lymph nodes were not palpable or tender. Gradually enlarging swelling appeared below the sinus area, which was surgically excised. Excisional biopsy confirmed the diagnosis of sebaceous adenoma of the left parotid gland. The tumour was composed of lobules of varying size showing sebaceous differentiation (Fig 1). Peripheral cells were basaloid in appearance (Fig 2). Ductal differentiation was also evident and there was no cytological atypia.

Currently, the patient is on antibiotics due to poor wound healing and subsequent secondary infection, which has been the case throughout the history. Fasting Blood Sugar (FBS) test, which has been carried out on the suspicion of immunosuppression due to diabetes mellitus, was found to be normal. No other predisposing factors have been revealed and the patient is tumour free 6 months after surgical treatment.

### **Discussion**

The term "sebaceous neoplasms" includes benign and malignant tumours with varying degrees of sebaceous differentiation. Skin is the commonest site for sebaceous neoplasms. Salivary glands can also be affected rarely.<sup>1,2,3,4</sup> Sebaceous glands are commonly found in the parotid and submandibular glands.<sup>1,2</sup> and rarely in the sublingual glands.<sup>2</sup> Sebaceous glandular elements have also been seen in intraparotid and periparotid lymph nodes.<sup>1</sup> Major salivary glands that are involved by inflammatory, cystic or neoplastic diseases may also show sebaceous differentiation.<sup>2</sup> The morphology and lipid component of these sebaceous glands, at least in the parotid gland, are identical to cutaneous sebaceous glands. Despite the common finding of sebaceous differentiation in major salivary glands, primary salivary gland sebaceous tumours are exceptionally rare and comprise of less than 0.2% of all benign and malignant salivary gland

tumours.<sup>1</sup> These include, sebaceous adenoma,<sup>1,2,5</sup> sebaceous lymphadenoma,<sup>1,2</sup> sebaceous carcinoma,<sup>2</sup> and sebaceous lymphadenocarcinoma.<sup>2</sup> A number of other salivary gland tumours have been reported to have focal sebaceous differentiation such as pleomorphic adenoma, Warthins tumour, mucoepidermoid carcinoma, adenoid cystic carcinoma, oncocytoma and basal cell adenoma.<sup>2</sup> The pluripotential character of salivary gland ductal epithelium is clearly demonstrated by the variety of lesions associated with sebaceous differentiation.

According to the cases from AFIP (Armed Forces Institute of Pathology) reviewed since 1985, SA represent about 0.7% of all adenomas of the major salivary glands.<sup>1,2</sup> Of the 21 cases reported for which the site of occurrence was known, 12 involved the parotid gland. The origin of sebaceous differentiation in salivary gland is debatable. Sebaceous elements could be the result of a metaplastic process secondary to ductal obstruction from a tumour or inflammatory process, or they could be congenital in origin or naturally develop later in life.<sup>2</sup> The incidence of sebaceous differentiation is observed to increase markedly after puberty, with a frequency of 10% to 20% being reported in young and middle aged adults.<sup>2</sup> Gnepp & Brannon argue of the possibility of the same factors that activate the sebaceous glands during puberty also activating those in the salivary glands.<sup>2</sup> A recent review of the literature.<sup>6</sup> showed that the mean age is 58 years with an age range of 22 to 90 years. There is a male predilection. Initially, most patients are asymptomatic, followed by a firm to hard slowly growing mass in the involved site as in the case with our patient. Duration of the swelling varies from 2 months to 15 years. The size of the tumour varies from 0.4 to 3.0 cm and macroscopically they are usually sharply circumscribed, but maybe focally cystic.<sup>1</sup> Colour varies from greyish white to yellowish grey.<sup>1,2,6</sup>

Sebaceous Adenoma of the Parotid Gland with Multiple Recurrences.

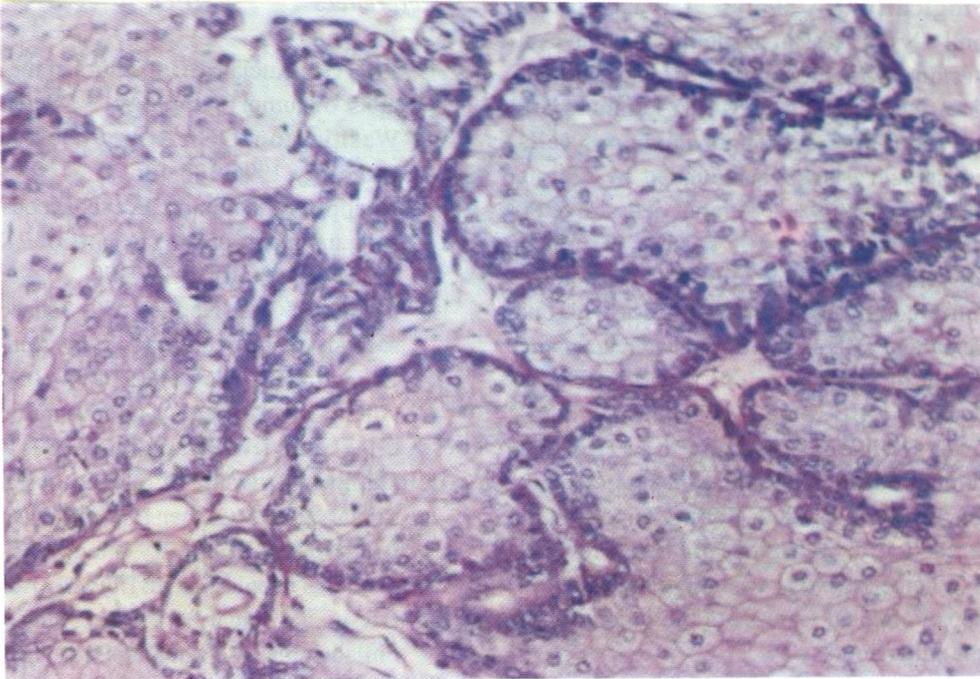


Figure 1 – Lobules of sebaceous differentiation with peripheral basaloid cells (x 200) Haemotoxylin & Eosin

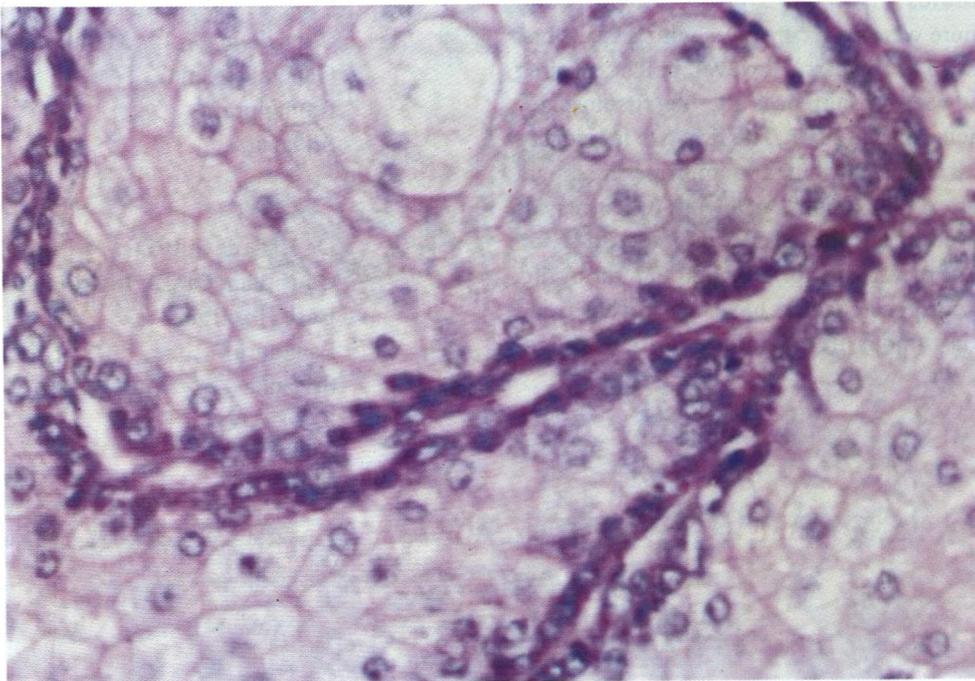


Figure 2 – Well differentiated sebaceous cells (x 400) Haemotoxylin & Eosin

Histopathologically, SA shows at least partial encapsulation.<sup>1</sup> Cystic areas in particular may have an irregular interface with surrounding tissues without evidence of a well defined capsule. Tumours are composed of sebaceous cells and squamous cells arranged in nests and islands, surrounded by fibrous stroma which maybe hyalinized. Tumour cells are often predominantly squamous with focal sebaceous differentiation, whereas in some tumours there maybe sebaceous cell predominance, as in the case with our patient. These tumour cells show minimal cellular atypia and no tendency of local invasion. Instead of these solid tumour islands, some cases show ductal differentiation or cyst like proliferations. In the reporting case, even though ductal differentiation was evident, cystic changes were not marked. Rarely, oncocytosis, foreign body reaction, or collections of histiocytes may be present.<sup>1,2</sup> Whether there is any significance of these variable histopathological features to the prognosis of SA is not well understood.

Treatment of SA is surgical excision of the tumour as for other benign salivary gland tumours. If the lesion is large, parotidectomy or partial submandibulectomy is mandatory. No recurrences have been recorded in previous studies.<sup>1,2</sup> In the study by Gnepp and Brannon,<sup>2</sup> there were no recurrences with the survival ranging from 1.5 to 16 years. However, in the reporting case there had been 4 recurrences after the first instance of tumour occurrence in 1991. The first two incidences of recurrences can be attributed to improper treatment with enucleation of the lesion. But the last two instances which followed surgical excision, point towards an unusual rate of recurrence for a benign tumour of this nature. No predisposing factors have been revealed and the patient is tumour free 6 months after surgical treatment.

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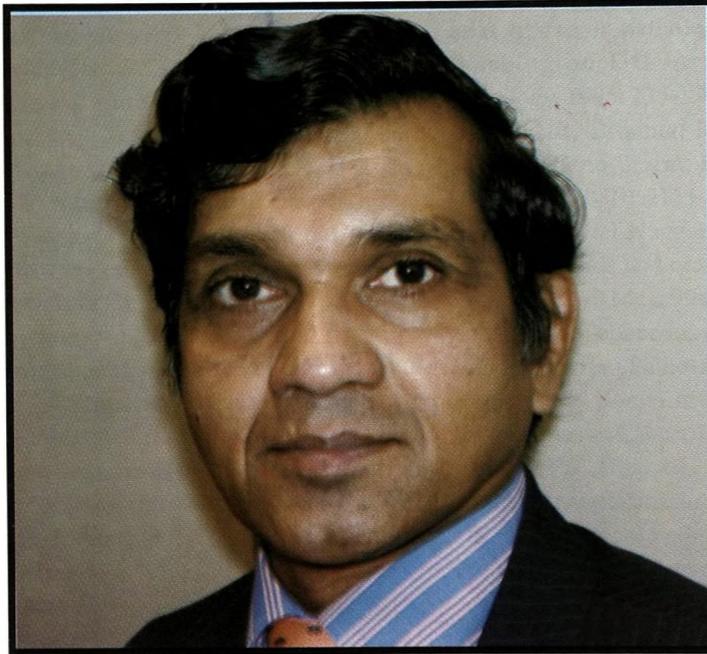
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## NEWS



**Professor DYD Samarawickrama**

Professor DYD Samarawickrama, BDS, PhD, FDSRCS, ILTM is an alumnus of the Dental School of the University of Ceylon at Peradeniya that was the forerunner of the current Faculty of Dental Science, University of Peradeniya.

He is currently the Professor of Conservative Dentistry, Queen Mary's School of Medicine & Dentistry, University of London. He is also the Senior Tutor, Dentistry and an Honorary Consultant in Restorative Dentistry, Barts & The London NHS Trust. He has been an Assessor for the International Qualifying Examination of the General Dental Council, UK for sometime. He is an external examiner for several universities in the UK.

He was formerly the Director of the Dental Auxiliary School, The London Hospital Medical College where he pioneered many innovative courses. He has been a former President of the British Association of Teachers of Conservative Dentistry.

He is very active in the Commonwealth as an executive committee member and the co-editor of the Commonwealth Dental Association. He is currently adviser to the Government and Dental Council of Barbados on registration of foreign trained dentists. He has been a Consultant to the World Health Organisation and the Pan American Health Organisation on Oral Health

He lectures widely on oral health issues and topics in restorative dentistry.

# THE COMMONWEALTH DENTAL ASSOCIATION

**Dr. Hilary Cooray**  
Dental Representative, SLMC

The Commonwealth Dental Association was formed on 25th April 1991 in Kuala Lumpur, Malaysia. The decision to form such an association was taken at a meeting of the Commonwealth Foundation.

The objectives of the association as laid down in the constitution is as follows:-

## Objectives

- 1.2.1 To develop and to promote primary oral health care strategies, including the application of appropriate technology in co-operation with National Dental Association in member countries, with emphasis on the prevention of oral and dental diseases.
- 1.2.2 To provide technical co-operation and advice to member associations of countries within the Commonwealth, in particular in the training of a professional and auxiliary oral health workforce and the cost-effective delivery of oral health care.
- 1.2.3 To promote the ethical practice of dentistry among member associations.
- 1.2.4 To facilitate continuing dental education programmes including distance learning for dental surgeons and oral health care personnel working in the Commonwealth countries.
- 1.2.5 To participate actively in the work of the Commonwealth health Ministers, insofar as is consistent with the Association's consultative and observer status. To liaise and work with WHO and with FDI.
- 1.2.6 To edit and to publish a regular bulletin and technical reports which shall be sent to all National Dental Associations within the Commonwealth, as well as to appropriate governmental, health and professional institutions.
- 1.2.7 To hold regular meetings and conferences and generally to carry on all such lawful activities as may be incidental to the promotion or carrying out of the foregoing aims and objectives of the Association.
- 1.2.8 To assist member countries to establish National Dental Associations where such NDAs do not exist.

## Regions

The activities of the Commonwealth Dental Association is organized through six regions.

1. Europe
2. South East Asia
3. Pacific/Australasia
4. Canadian/Caribbean
5. West Africa
6. East, Central and Southern Africa

The 4<sup>th</sup> triennial meeting of the CDA was held at the Safari Park Hotel in Nairobi Kenya in collaboration with Kenya Dental Association and FDI World Dental Federation, Continuing Education Programme.

This was held once in two days and addressed by many eminent speakers. Some of the Lecturers and workshops during the conference were, Capacity building in Africa by Professor Raman Bedi, Chief Dental Officer, England and Wales. Periodontology by Professor Jacob Kaimenyi (Kenya) Infection control and risk management by Dr. John Hunt (OSAP, UK) and Dr. Brain Mouatt (CDA, UK) Dental training by Professor Goran Koch (Sweden) and Practice Management by Dr. Jennifer De St Georges(USA).

There were many other interesting presentations by eminent speakers from various regions of the world. The General Assembly of the Commonwealth Dental Association was held on 13<sup>th</sup> and 14<sup>th</sup> December 2003.

At this meeting the Sri Lanka Dental Association placed a bid to hold the 5<sup>th</sup> triennial meeting in Sri Lanka in 2006. The following office bearers were elected.

### CDA New Executive (2003-2006)

President	-	Dr. L.L.Gandhi (India)
Executive Secretary	-	Dr.Sam Thorpe OR (Sierra Leone)
Treasurer	-	Dr. Anthony S.Kravitz OBE (UK)
President Elect	-	Prof.Jacob Kaimenyi (Kenya)
Immediate Past President	-	Brian Mouatt CBE (UK)

### CDA Regional Vice – Presidents:

Europe	-	Dr.John Hunt OBE (UK)
South East Asia	-	Dr. Hilary Cooray (Sri Lanka)
Pacific/Australasia	-	Dr. Temalesi King (Fiji)
Canada/Caribbean	-	Dr.Joyous Pickstock (Bahamas)
West Africa	-	Dr.Kofo Savage (Nigeria)
East, Central & Southern Africa	-	Dr. Pashane Mtolo (Zimbria)

The previous triennial meetings have been held in :-

1. Malaysia (inaugural)
2. Trinidad
3. The United Kingdom
4. Kenya

## The Commonwealth Dental Association

Since the Annual General Meeting, the Commonwealth Dental Association convened a planning conference for Oral Health in the Africa region from the 14<sup>th</sup> to 16<sup>th</sup> April. This was supported by the FDI/WHO.

### Main Outcomes of the Meeting

At the final session of the second day, participants approved the “Nairobi Declaration on Oral Health in Africa”.

The following plan of work was agreed upon:-

Develop oral health policies for African countries.

Address the environmental and lifestyle deterrents of oral diseases, such as tobacco/alcohol, fluoride, nutrition, causes of facial trauma and others;

Actively pursue health promotion/disease prevention strategies;

Integrate oral health strategies within broader general health policies and programmes;

Improve access to essential oral health care for the communities.

At the meeting of the executives of the CDA held in New Delhi on 11<sup>th</sup> September 2004, the Sri Lanka Dental Association's invitation to host the 5<sup>th</sup> Triennial Meeting in Sri Lanka was unanimously accepted. The S.L.D.A. is now given the task of organizing an excellent and a memorable meeting on the 15<sup>th</sup> October 2004. The council of the SLDA appointed an Organizing Committee for this purpose. It is as follows:-

Dr.Hilary Cooray	-	Chairman
Dr.Prasad Amaratunga	-	President Elect 2004-2005]
		President 2005-2006] Ex Officio
Prof. Malkanthi Chandrasekara	-	President 2004-2005 (Ex Officio)
Dr.Sama Weeraperuma	-	Secretary (Ex Officio)
Dr.R.Kanna	-	Treasurer(Ex Officio)
Dr.Lional Dassananayke	-	Chairman (Scientific Programme)
Dr.Mano Fernando		
Dr.Malcolm Stanislaus		
Dr.Sunil Gunaratne		
Dr.Vipula Wickremasinghe		
Dr.Jayasundara Bandara		
Dr.M.D.Abdul Wajith		
Dr.Kumar Warnakula	-	Secretary of the Committee

### Inspection Visit of President Commonwealth Dental Association

Dr.L.K.Gandhi, President of the Commonwealth Dental Association will be visiting Colombo in November 2004 to inspect whether it has the requisite facilities for hosting this conference. He will be accompanied by his Wife and

Dr.Manjith Singh, Secretary Organising Committee of F.D.I.

### **Instructions for Authors**

The Sri Lanka Dental Journal publishes the following categories of articles which have relevance to Dentistry and allied sciences

1. Leading articles – One article per issue. It may be solicited by the Editor. Authors are welcome to submit leading articles on current topics of interest, one's expertise or commentaries on general practice etc. They should be approximately 1500 words in length. References should be 20 or less.
2. Reviews – Reviews are detailed surveys of published research pertinent to dentistry and associated sciences. They should be critical in nature and should not normally exceed 3000 words and 30 references
3. Research articles – Articles resulting from research work belong to this group. Results from routine clinical examinations or laboratory investigations will not be considered under this category. Subjects may vary from clinical trials to basic science research, historical analysis to dental economics. They should not exceed 3000 words and 30 references. A reasonable number of tables and illustrations will be accepted.
4. Short reports – These include reports on current topics, modified techniques, new materials, practice management etc. Interesting results from routine clinical work or laboratory investigations also may be accepted.
5. Case reports – Reports such as of rare diseases or conditions, modifications to accepted treatment procedures, new management methods etc. may be included in this category.
6. Letters to Editors – Subjects unlimited, but may include short critique of published papers in the SLDJ.
7. Miscellaneous topics – Subjects unlimited and the format are free. These may also include details of scientific meetings, conferences, annual sessions, examinations, news and views, visits and obituaries.
8. Proceedings of annual sessions – Abstracts from annual sessions of the SLDA and other colleges will be published under this category.

### **Submission of manuscripts**

Authors submitting a paper do so on the understanding that no part has been published before, that it is not being considered for publication elsewhere and that it has been read and approved by all the authors.

Manuscripts including Tables and Figures should be sent in triplicate as the work will be reviewed by two or more referees. While papers are subject to editing, the journal does not hold it responsible for statements made by the contributor. The author alone is responsible for the statements made in his paper.

Submission of a manuscript means that authors automatically agree to assign exclusive copyright to the Sri Lanka Dental Association if and when the manuscript is accepted for publication.

### **Manuscript on disk**

Once an article has been accepted for publication, the author will be asked to supply a copy of the final manuscript on disk together with two copies of the complete manuscript. Every disk must be clearly labelled with the name of the author, title, software and program version number.

### **Manuscript style**

The manuscripts should be typed, double-spaced, on A4 (212x297 mm) paper and submitted in correct English; both English and American spelling are acceptable, provided this is consistent throughout the manuscript. Manuscripts not submitted in proper format or in poor English may be returned without review. The format of a manuscript should be as

follows: Title page. Abstract, Introduction, Material and methods. Results. Discussion. Acknowledgements. References, Figure legends, and Tables, arranged in that order.

**Title page** - The title page should contain the following information in the order given: 1) a concise but informative title; 2) author's full names (without degrees and titles); 3) author's institutional affiliations; 4) a running title, not exceeding 40 letters and spaces; 5) name, address, telephone, telefax and electronic mail address of the author responsible for correspondence.

**Abstract page** - Original and review articles must contain an abstract of approximately 250 words with four specified subtitles:

- 1) **Objective:** An introductory sentence indicating the objective and purpose of the study.
- 2) **Material and methods:** A description of experimental procedure including applicable statistical evaluation.
- 3) **Results:** A summary of the new, previous unpublished data and results.
- 4) **Conclusion:** A statement of the study's conclusion  
3-5 key words according to Index Medicus should be provided.

**Introduction** - The introduction should carry sufficient background information on the subject of study.

**Material and methods** - Procedures should be described in such detail as to make it possible to repeat the work. Subheadings may be used to improve clearness. Correct unit abbreviations should be used (e.g., "h", "min", "s" and "µm" rather than "hr", "minutes", "sec" and "µ", respectively).

The authors should consider the ethical aspects of their research and ensure that the work has been approved by an appropriate Ethical Committee. Where applicable,

a copy of the ethical clearance certificate should be attached. In human experimentation, informed consent from individuals should be obtained and this should preferably be stated.

**Statistical analysis** - Since many scientific investigations rely on statistical treatment, authors are strongly urged to consult a person with in-depth statistical knowledge. Manuscripts with a clear element of statistics are regularly refereed by the Journal's statistics consultant.

**Results** - The Results section should clearly and concisely present the findings of the research, as a rule in the past tense without subjective comments and reference to previous literature. The results should be supported by statistical or illustrative validation. For the sake of clarity this section may have subheadings.

**Discussion** - This section should present the interpretations of the findings and is the only proper section for subjective comments. Authors are strongly urged to avoid undue repetition of what has been reported in Results.

**Tables** - The tables should be numbered in the order of appearance in Arabic numerals. Each table should have a brief explanatory title. Each table should be typed on a separate sheet, with due regard to the proportion of the printed column/page.

**Figures** - All graphs, drawings, and photographs are considered figures and should be numbered in the order of appearance in Arabic numerals. Each figure should have a brief and specific legend, and all legends should be typed together on a separate sheet of paper. Photographs should be glossy prints and the reverse should give the figure number, title of paper, principal author's name and have a mark indicating the top. Colour illustrations may be submitted in instances where their use may contribute significantly to the scientific value of the article. Colour illustrations may be printed free of charge at the Editor's discretion, whereas others may be printed at the author's expense.

**References** - References are listed double-spaced in a separate reference section immediately following the text. References are numbered consecutively in the order in which they appear in the text; do not alphabetise. Identify references in texts, tables and legends by Arabic numerals (within parenthesis).

Congress abstracts should not be used as references nor may "unpublished observations" and "personal communications" be placed in the reference list. References cited as "in press" must have been accepted for publication and not merely in preparation or submitted for publication

Examples of correct forms of references are given below. These are based on the format used in the *Index Medicus*. Abbreviate journal names according to the *List of Journals Indexed*, printed annually in the January issue of *Index Medicus*. List all authors; do not use *et al.* in the reference list.

### **Journals**

Standard journal article

Bartlett JG, O'Keefe P. The bacteriology of the perimandibular space infections. *J Oral Surg* 1979; 37: 407-409.

Corporate (collective) author

WHO COLLABORATING CENTRE FOR ORAL PRECANCEROUS LESIONS. Definition of leukoplakia and related lesions: an aid to studies on oral precancer. *Oral Surg Oral Med Oral Pathol* 1978; 46: 518-539.

Unpublished article

Barker DS, Lucas RB. Localised fibrous growth of the oral mucosa. *J Dent Res* 1965; in press.

Books and other monographs

Pindborg JJ. Atlas of diseases of the oral mucosa. 5<sup>th</sup> edition. Copenhagen: Munksgaard, 1992; 50-66.

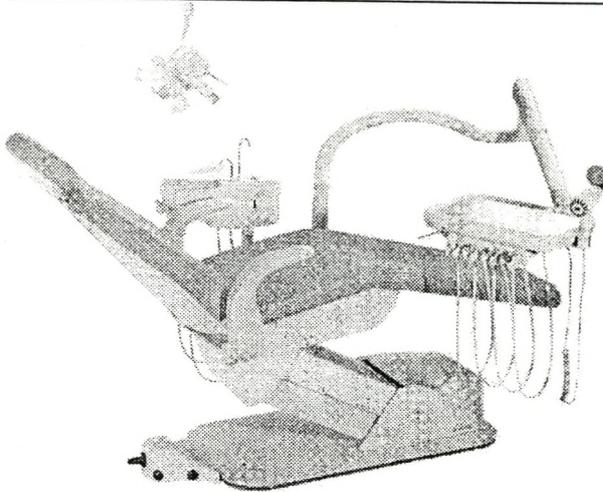
Chapter in book

Boyde A. Amelogenesis and the structure of enamel. In: Cohen B, Kramer KH (eds). *Scientific Foundations of Dentistry*. William Heinemann Medical Books Ltd. London, 1976; 335-352.

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International statistical classification of diseases and related health problems, 10<sup>th</sup> revision, vol 1. Geneva: World Health Organisation, 1992; 550-564

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