Interspecies Communication in Oral Biofilm

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ABSTRACT

Microorganisms can live and proliferate as individual cells swimming freely in the environment, or they can grow as highly organized, multicellular communities encased in a self-produced polymeric matrix in close association with surfaces and interfaces. This microbial lifestyle is referred to as biofilms. This review summarizes the interaction between different microbial species present within a biofilm and how they communicate with each other.

Keywords: Biofilm, Microorganisms, Polymeric matrix.


Introduction

Traditionally, social cooperation has been considered the preserve of higher organisms. Man forms and dwells in a community benefiting each other for survival and maintaining its existence. Only in relatively recent times have biologists begun to appreciate that bacteria are also highly interactive creatures having complex, fascinating and diverse social lives and so, similar to the human being who is said to be a social animal, they also form and survive in a ‘society’ called ‘Biofilm’.

A biofilm can be defined as a surface-attached (sessile) community of microorganisms growing embedded in a self-produced matrix of extracellular polymeric substances (EPS) (Fig. 1), which consists of polysaccharides, proteins, lipids, nucleic acids and other polymers, and help them to adhere to the surface, as well as to each other. Upon secretion of the EPS, the biofilm matures by enlarging and taking on a distinctive architecture.

The dental plaque biofilm has an organized heterogeneous structure within a matrix which confers a specialized environment, which distinguishes bacteria that exist within the biofilm from those that are free floating, the so-called planktonic state, in solutions such as saliva or crevicular fluid. The bacteria exist and proliferate within the intercellular matrix through which the open fluid-filled channels run (Fig. 2). Nutrients make contact with the sessile (attached) microcolonies by diffusion from the water channels to the microcolony, rather than from the matrix.

In order for any community to succeed, there must be good communication among its members because communication is a basic element in successful organizations. Biofilm communities appear to be no different. The first response of bacteria in a biofilm is attachment to a surface, which proliferate and enlarge through communication. If adherence is nonspecific, then all bacteria can attach to oral surfaces, and this does not occur. After adherence, bacteria form multispecies communities. Communication among microorganisms is essential for initial colonization and subsequent biofilm formation on the enamel surfaces of teeth and requires physical contact between colonizing bacteria and between the bacteria and their host. Without retention on the tooth surface, the bacteria are swallowed with the saliva. Through retention, these bacteria can form organized, intimate, multispecies communities.

The changes that occur in populations of bacteria on tooth surfaces after cleaning are ordered and sequential. The initial attachment of bacteria begins with pellicle formation (Fig. 3). The pellicle is a thin coating of salivary proteins that attach to the tooth surface within minutes after a professional or self cleaning which acts like a double-sided adhesive tape, adhering to the tooth surface on one side and on the other side, providing a sticky surface facilitating bacterial attachment to the tooth surface. With the attachment of each new cell type, a nascent surface is presented for the attachment of other kinds of bacteria, resulting in a progression of nascent surfaces and concomitant changes in species diversity. Such coordination indicates communication. In the absence of communication, these orderly changes would be random.

The pellicle is a source of receptors recognized by the primary colonizers of dental plaque.
These receptors include as follows:

- Mucins,
- Agglutinins,
- Proline-rich proteins,
- Phosphate-rich proteins, such as statherin, and
- Enzymes, such as alpha-amylase.

Following pellicle formation, bacteria begin to attach to its outer surface (Fig. 3). Bacteria connect to the pellicle and each other with hundreds of hairlike structures called fimbriae. Once they stick, the bacteria begin producing substances that stimulate other free floating bacteria to join the community. The biofilm grows primarily through cell division of the adherent bacteria, rather than through the attachment of new bacteria (Fig. 4).

A handful of chemical signals that have a role in biofilm development in the oral cavity have been identified and characterized.

Quorum sensing (QS) is signaling mediated by autoinducing diffusible molecules, acting upon the producer organisms when population density rises above a threshold level. This involves the regulation of expression of specific genes through the accumulation of signaling compounds that mediate intercellular communication. When these signaling compounds reach a threshold level (Quorum Cell Density), gene expression can be activated. The latter can occur more easily in microcolonies because the signaling compounds do not dissolve in the surroundings, and thus remain concentrated.

Quorum sensing is one of the communication mechanisms which has been known since the end of the 1960s and it was originally discovered in the luminescent bacterium Vibrio fischeri.

In planktonic populations of these same kinds of cells (Fig. 5), chemical signals produced by them (HSLs, for homoserine lactones) are not concentrated enough when passed through the water to cause changes in genetic expression.
expression. However, in biofilms, the matrix material (EPS) that holds cells close together allows concentrations of cell-produced chemical signal molecules (HSLs) to buildup in sufficient quantity to cause changes in cellular behavior (Fig. 6). This system of population recognition has been termed ‘QS’ (this comes from the same term used in a committee when enough members are present to legally take some action).

In Figure 7, a schematic diagram of various species of bacteria is represented by different colors. Bacteria can produce chemical signals (‘talk’) and other bacteria can respond to them (‘listen’) in a process commonly known as cell-cell communication or cell-cell signaling.

In addition to signal exchange between partners that utilize the same or related signal molecules, bacteria can also ‘eavesdrop’ on the communication of other organisms, modulating their behavior in response to cell-cell signals that they do not synthesize.

Most of the cultured species of oral bacteria have been tested for their ability to physically interact with and adhere to different species, and all display specific recognition patterns with their respective partner cells. This recognition between genetically distinct cells in suspension and resultant clumping is called coaggregation.

Coaggregation bridges are mechanisms of cooperation because they bring together two species that are not coaggregation partners. Recognition between a suspended cell type and one already attached to a substratum is termed coadhesion (Fig. 8). These interactions often appear to be mediated by complementary protein-adhesin and saccharide-receptor components on the two cell types. It is postulated that coaggregation and coadherence are integral to communication between species. *Streptococcus* is the only genus of oral bacteria that demonstrates extensive intrageneric coaggregation as well as intergeneric coaggregation.10

It is known from *in vitro* studies that monolayers of oral bacteria release enzymes that mediate their detachment. Thus, it is likely that localized detachment of
microorganisms starts after initial adhesion and increases with time. The fact that microorganisms detach regularly has implications for their spreading and colonization to other sites.

The bacterial species are placed in either of two general categories, early colonizers or late colonizers. Early colonizers include species of Actinomyces, Capnocytophaga, Eikenella, Haemophilus, Prevotella, Propionibacterium and Veillonella.

Fusobacterium nucleatum, is found to be unusual and is intentionally placed at the border between early and late colonizers for the following reasons:

- It is always present whenever Treponema denticola and Porphyromonas gingivalis are present, suggesting that its presence predates that of the other two species and may be required for their colonization.
- It coaggregates with all of the early colonizers and the late colonizers.

The bacteria representing early colonizers coaggregate with only a specific set of other early colonizers and generally not with any of the late colonizers and although all the late colonizers coaggregate with F. nucleatum, they generally do not coaggregate with each other. A few exceptions, such as T. denticola coaggregating with P. gingivalis, have been reported. Thus, F. nucleatum acts as a bridge between early and late colonizers (Fig. 9).

Among other signal compounds, the autoinducer signal molecules produced by bacteria are structurally diverse. Autoinducer-2 (AI-2) is proposed to be a signal, mediating messages among different species in a community. It refers to a collection of excreted molecules spontaneously cyclized from 2(4,5-dihydroxy-2,3-pentanedione) (DPD), the product generated by the enzyme encoded by the luxS gene. The luxS gene is found in many species of oral bacteria, which suggests that it plays a significant role in communication between species within oral biofilms.

Many Gram-negative bacteria use N-acylhomoserine lactones (AHL) as signals and many Gram-positive bacteria use amino acids or modified peptides as signal molecules. The only cell-cell signaling system identified to date that is shared by both is mediated by AI-2 (Fig. 10).
Chemical signaling occurs between two species when a metabolite from one species induces a change in the other species. Underlying the biofilms is a chemical exchange involving the consumption of sugars and complex carbohydrates. Lactic acid, which is produced as a by-product of fermentation, is the preferred carbon source for at least two species commonly found within dental biofilms: *Veillonella atypica* and *Aggregatibacter actinomycetemcomitans*. The preference for lactic acid forms the basis of a synergistic chemical exchange between species for multispecies biofilm development in the oral cavity.

Sugar fermentation by *Streptococcus* species produces an accumulation of lactic acid, which in turn supports the growth of *V. atypica* and *A. actinomycetemcomitans*.

An emerging theme in the area of interspecies signaling is the involvement of antibiotics, which have not been considered to be intraspecies signals. At low concentrations, some antibiotics have effects on bacterial behavior and gene transcription that are distinct from those known or proposed to contribute to increased antibiotic tolerance, suggesting a role in signaling. Antibiotics at sub-inhibitory concentrations can act as interspecies lantibiotic synthesis and that may be a mechanism for controlling susceptible streptococci in the human oral cavity.

Transfer of genes by competence-inducing pathways is one of the most-studied forms of communication by oral bacteria. This method of communication is mediated by competence stimulating peptides (CSPs).

Signaling by soluble molecules also occurs between *Streptococcus salivarius* and *Streptococcus pyogenes* by the Lantibiotic peptides that modulate their own and interspecies lantibiotic synthesis and that may be a mechanism for controlling susceptible streptococci in the human oral cavity.
interspecies signaling molecules that may regulate the homeostasis of microbial communities.

We are living in an ocean of bacteria. Our oral cavity contains more than 700 bacterial species.\textsuperscript{11} They produce signaling molecules acting as their ‘Gyanendriyan’ (sensory organs) to communicate in the biofilm (Fig. 11).

So, according to Hans Zinsser (1934), however, secure and well-regulated civilized life may become, bacteria will always lurk in the shadows ready to pounce when neglect lets down the defenses.

REFERENCES

Dermatoglyphics in Oral and Systemic Diseases

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ABSTRACT

Background: Dermatoglyphics refers to the study of epidermal ridge patterns of fingers, palms and soles of hand and feet. Fingerprint develops completely at 24th week of embryonic life. Once formed, they are permanent and unalterable throughout the life, not affected by environmental factors. As dermatoglyphic patterns are assumed to be associated with genetic factors, the idea of using it as supportive evidence in the diagnosis of hereditary disorders becomes a reality, although the exact mechanism of inheritance is still unknown. Serious medical and dental diseases like cancer, diabetes, heart diseases and hypertension, dental caries, periodontitis, and malocclusion had also been studied for early prediction. So, hypothetically some association between particular dermatoglyphics pattern of these patients are expected, that aids the clinician to initiate early preventive measures. Hence, the present paper reviews the brief knowledge on dermatoglyphics.

Keywords: Dermatoglyphics, Embryonic, Environmental, Epidermal ridge, Fingerprints, Genetic, Hereditary, Inheritance, Knowledge.


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INTRODUCTION

The word dermatoglyphics is derived from two Greek words derma and glyphae, derma means skin and glyphae means carvings. Dermatoglyphics refers to the scientific study of epidermal ridge patterns found on the volar pads of fingers, palms and soles of hand and feet. The volar pads are elevation at the distal metacarpal bone of each finger. The epidermal ridges are formed due to continuous friction occurring in the above areas. Two type of ridges, primary and secondary ridges are formed. The primary ridge forms the dermatoglyphics pattern. Secondary ridges are modified into sebaceous glands and are found above primary ridges. The epidermal ridges of the hand and feet were first studied by Joannes E Purkinje in 1823. William Hershel in 1858, first introduced fingerprints in India for personal identification. Sir Francis Galton in 1892, published the first book on fingerprints. Cummins and Midlo in 1926 were the first to coin the term dermatoglyphics. Sir Harold Cummins is acknowledged as father of dermatoglyphics. Fingerprints begin to form at the 6th week of the embryonic life and develops completely at 24th week except the dimensions related to the growth of the body. Once formed, the fingerprints are permanent and unalterable throughout the life except in cases of serious injuries, in which the dermis of hands and feet changes. Not even the monozygotic twins have the same fingerprints. Fingerprints of both hands of same individual are not identical.

Over the past 150 years, dermatoglyphics has been a useful tool in field of anthropology, biology, medicine, genetics, evolution, crime detection, twin diagnosis and racial variation and personal identification. Serious medical diseases, like cancer, diabetes, heart diseases and hypertension had been studied for early prediction by dermatoglyphics. Dermatoglyphics was first studied in cancer field in 1977. This science has also been utilized in diagnosis of many congenital abnormalities, schizophrenia and leukemia. Dermatoglyphics can aid the clinician to early detect health problems in individuals and enables them to initiate early preventive and protective health measures.

ADVANTAGES

The main advantages of the dermatoglyphics are as follows:

- Finger and palm prints scanning or recording can be done rapidly with ease.
- Economical method.
- Noninvasive method without causing any trauma to the patient.
- No hospitalization is required.
- Minimum equipments are needed.
- Data collected can be preserved for longer duration for future references.
- Give better details in children, as they have fine finger prints.

TYPES OF FINGERPRINTS

Plastic impressions: Prints are formed in soft material, like butter, soap, etc.
Visible prints: Prints are formed when fingers are covered in blood, dirt, oil, paint.
Latent prints: Prints are not visible to the human eye until chemical is applied.

Methods of Recording Dermatoglyphics

The various methods for recording fingerprint pattern are the following:

Ink method: This is the most widely used method. The equipment includes printer’s ink, a roller, a glass slab, a sponge rubber, and glazy paper. This method is not suitable for uncooperative children and those with very fine ridges. The prints obtained are of poor quality, which do not allow accurate counting of ridges.8

Inkless method: This method was described by Walker. The equipment includes commercially available patented solution and paper. It is not popular currently. The method is good for hands or feet prints with well-demarcated patterns.9

Transparent adhesive tape method: The dry colored pigment, like colored chalk, dust, India ink, standard ink, carbon paper, and powdered graphite is applied to the skin and transparent adhesive tape is used to lift of the prints clearly. This method is inexpensive, rapid and easy to use with all types of patients.8

Photographic method: The principle of total internal reflection is used. When an object is pressed against a prism, the magnified image is photographed by a Polaroid camera. It is an expensive method.7

Special methods: These methods are not widely used. The study of the correlation between the epidermal patterns and the underlying bone structures (radiodermatography), study of sweat pores (hygrophotography), can be done.7

Integrated automated fingerprint identification system: This method scans the fingerprints into a computer database, which transforms it into digital image. Then the unknown prints are identified with several possible matches. This method does not make final verification of print identity, finds closest correlation to the search prints.8

Ultraviolet imaging system: This method do not use any chemical or powder. When ultraviolet light strikes the fingerprint, light is reflected back to the viewer showing the print from its background surface.7

Chemical methods for latent prints visualization:

- Iodine fuming: Suspect material, when kept in closed container with iodine crystals and get heated, vapor reacts with latent print to make it visible. Iodine prints are not permanent.
- Superglue fuming: Superglue when applied on nonporous surfaces of object and get heated after applying sodium hydroxide, produces toxic fumes of cyanide. When fumes and object packed in container for 6 hours, produces white latent print.7

DERMATOGLYPHIC LANDMARKS

The dermatoglyphic landmarks found on fingertips are the following:

Triradius: It is formed by the joining of three ridges that makes angles of 120° with one another.1 The center of the triradius is known as a triradial point. They are commonly located in the hypothenar areas of the palms.10

Core: It is the center of the pattern. It may be circular or elliptical shape in the center of the pattern.10

Radiant (delta): A place where two lines run side by side and then diverge with a significant recurving line which passes in front to form a triangle known as delta. They move from the triradius and enclose the pattern area (Fig. 1).1

The dermatoglyphic landmarks found on palms are the following:

Thenar area: The area which lies anatomically closer to the thumb side on the palm (Fig. 2).

First, second, third and fourth interdigital area: The area which lies in between the interdigital regions of thumb, index finger, middle finger, ring finger and little finger are known as interdigital area.

Hypothenar area: The area which lies anatomically closer to the little finger side on the palm.
Triradii point a, b, c, d, t: The center point present at the base of index finger, at the base of middle finger, at the base of ring finger, at the base of little finger are known as triradii point a, b, c, d and center point present near wrist is known as triradii point t.11

DERMATOGLYPHICS QUALITATIVE ANALYSIS

Patterns of Finger Ridge

The finger ridge patterns are of three types: arches, loops, and whorls (Figs 3A to D).

Arches: It is the simplest type of pattern. It has no delta. It is formed when one or more epidermal ridges enter from one side of the pattern area and exit from other side forming a arch like curve at the center. The curve of arch may be low or high. The arch pattern is further of two types:

• Simple or plain arch is formed by the ridges that cross the fingertip from one side to the other with little recurving at the center.
• Tented arch is formed by the ridges that cross the fingertip from one side to the other with a tent like elevation at the center.

Loops: It is the most common type of pattern. It consists of core and one delta. It is formed when one or more epidermal ridges enter the pattern area from one side, recurves and exit from the same side. The loop pattern is further of two types:

• Ulnar loop is formed by the ridges that enter the pattern area, recurves and exit from the little finger side.
• Radial loop is formed by the ridges that enter the pattern area, recurves and exit from the thumb side. Sometimes, transitional loops is formed which is similar to complex whorl patterns.

Whorls: It consists of core and two deltas. The whorl patterns are further of four types (Figs 4A to C):

• Plain/simple/concentric whorl is formed by the loop that surrounds the core in concentric rings pattern and touches or cross the line joining the two deltas.
• Double Loop whorl is formed by two loops and two deltas.
• Central pocket whorl is formed by a small loop, which do not cross the line joining the two deltas.
• Accidentals/complex pattern is formed differently from the above whorl pattern.1,12

DERMATOGLYPHICS QUANTITATIVE ANALYSIS

Many dermatoglyphic characteristics can be described quantitatively (Fig. 5):

Ridge counting: The number of ridges counted from core to the delta is known as ridge count.

Total finger ridge count: The total number of ridges is counted from core to delta in all the 10 fingers of an individual is known as total finger ridge count.
Measuring the distances:

- **ab palmar distance**: A straight line is drawn and measured between triradii point a and b.
- **bc palmar distance**: A straight line is drawn and measured between triradii point b and c.
- **cd palmar distance**: A straight line is drawn and measured between triradii point c and d.
- **ad palmar distance**: A straight line is drawn and measured between triradii point a and d.

Measuring the angles between specified points:

- **atd angle**: Triradii point a, t and d is joined with a scale to form a triangle, and atd angle is calculated by protractor.
- **adt angle**: Triradii point a, t and d is joined with a scale to form a triangle and adt angle is calculated by a protractor.
- **dat angle**: Triradii point a, t and d is joined with a scale to form a triangle and dat angle is calculated by a protractor.

### USE OF DERMATOGLYPHICS IN DENTISTRY

The uses of dermatoglyphics in dentistry are as follows:

- **Dermatoglyphics in cleft lip and palate**: Zarakauskaite E et al in 2004 found significant increase in arches, double loops and ulnar loops in cleft lip and palate patients than in control. Scott NM et al in 2005 found increased radial and ulnar loops in cases. Mathew L et al in 2005 found increased frequency of ulnar loops on all fingers and increased frequency of t triradii on the palms of the patients with juvenile periodontitis, a decreased frequency of double loops on all fingers and an increased frequency of radial loops on the right second digits of the patients with rapidly progressing periodontitis, and the increased whorls and ulnar loops pattern on all fingers of the patients with adult periodontitis.

- **Dermatoglyphics in dental caries**: Their patterns showed increased whorls, higher total finger ridge count and higher interdigital radial and ulnar loops. Padma et al in 2011 evaluated the dermatoglyphic patterns of deaf and mute children and found that caries group had increased whorl pattern while caries free had increased loop pattern. Sharma A et al in 2009 found significant difference in loops between the caries and caries free group.

- **Dermatoglyphics in periodontal diseases**: Atasu M et al in 2005 found decreased frequency of ulnar loops on all fingers and increased frequency of t triradii on the palms of the patients with juvenile periodontitis, a decreased frequency of double loops on all fingers and an increased frequency of radial loops on the right second digits of the patients with rapidly progressing periodontitis, and the increased whorls and ulnar loops pattern on all fingers of the patients with adult periodontitis.

- **Dermatoglyphics in potentially malignant disorders and oral carcinomas**: Tamgire DW et al in 2013 studied the dermatoglyphic prints of gutkha chewers with and without oral submucous fibrosis (OSMF). He found that there was decrease simple whorl and increase composite whorl pattern on left little finger, decrease composite whorl on right index finger, increase simple whorl on right thumb, increase composite whorl on left thumb, and decrease radial loop on left index finger in gutkha chewers with OSMF. Elluru Venkatesh in 2006 studied the dermatoglyphic patterns of oral squamous cell carcinoma, oral leukoplakia and individuals with habits and no lesions as controls. Arches and loops were increased in cases than in controls that had more whorl pattern. Loops were increased in the interdigital areas in cases than in control. adt angle, ab count and total finger ridge count had no relation among the cases.

- **Dermatoglyphics in bruxism**: Polat MH et al in 2012, found increased whorls pattern and t triradii and decreased ulnar loops and adt angle than the controls. Total finger ridge counts and a-b ridge counts were almost similar in both study and control group.
Dermatoglyphics in malocclusion: Reddy S et al in 1997 found that class II, div\(^{1}\) and div\(^{2}\) patients had increased arches, ulnar loops and decreased whorls pattern, while class III patient had increased arches, radial loops and decreased ulnar loops pattern taking class I as control group. Tikare S et al in 2010 found correlation between whorl patterns in classes I and II malocclusion.\(^{3}\)

Dermatoglyphics in Kanner’s syndrome: These patients have increased frequency of arches in fourth and fifth fingers of right hand and first finger of left hand, and decreased frequency of arches in fourth and fifth fingers.\(^{4}\)

Dermatoglyphics in Down’s syndrome: Their pattern showed increased frequency of creases, bilateral radial loops on digits of ring and little finger and increased ulnar loops.\(^{4}\)

Dermatoglyphics in hypoparathyroidism: Their pattern showed increased arch.\(^{4}\)

Dermatoglyphics in Rubinstein Taybi syndrome: Their pattern showed four or more bilateral arch pattern.\(^{4}\)

Dermatoglyphics in obsessive compulsive disorder: Balgir RS et al in 2001 studied patients with obsessive compulsive disorder and found significant increase in the ulnar loop with a ridge count of 2 to 3 on the forefinger, and a proximal crease on the palm of the patients than in the control.\(^{4}\)

Dermatoglyphics in genodermatosis: Kuklin VT in 2001 studied the dermatoglyphic patterns and found dermatoses patients had suppressed loop pattern than the control. Blackwell D in 2002 found significant increased in the ulnar loop pattern in dairers diseases. Cusumano D in 2003 studied the dermatoglyphic patterns of atopic dermatitis and found significant higher whorl pattern in the atopic group than in control.\(^{4}\)

Dermatoglyphics study in Schizophreni: Their dermatoglyphic pattern showed increased number of arches and loops and less whorls.\(^{3}\)

Dermatoglyphics in cancer studies: A study showed decreased radial loop patterns on the first, second, third and fourth digits of the left hand, and the second digit of the right hand in squamous cell carcinoma. In another study, it was found that male’s right hand had increased radial loops while female’s left hand had an increased atd angle in acute myelogenous leukemia. Menser MA et al found increased arches and decreased ulnar loops in acute blast cell leukemia.\(^{10}\)

Dermatoglyphics to identify different blood groups: The dermatoglyphic patterns in different blood groups were studied and it was found that, whorls pattern was predominantly associated with in B blood group, while loop pattern was most commonly found in candidates with O blood group. Arch pattern was predominantly associated with AB blood group. RH negative blood group had more arches than Rh positive blood group.\(^{14}\)

Dermatoglyphics and hypertension: A study showed that total finger ridge count of more than 1000 with increase whorl pattern (100% in first right digit of males) are found in patients with essential hypertension. Another study showed that hypertensive male and female had increased whorls and total finger ridge count and decreased ulnar loops and ‘atd’ angle in both hands.\(^{15}\)

Dermatoglyphics in myocardial infarction: Jalali F et al in 2002 studied the dermatoglyphic patterns of myocardial infarction patient and found 7.2% arch, 46.8% loop, and 46% whorl type pattern. In control, they were 3.7, 50.7 and 45.5% respectively. Arch pattern was significantly increased in left thumb, left forefinger and left ring finger in the patients.\(^{4}\) Another study showed that the patients showed increased whorl pattern, decreased mean total finger ridge count, increased a-b, c-d ridge counts and decreased b-c ridge count. Mean atd angle was wider in the MI patients than that of the controls.\(^{16}\)

Dermatoglyphics in diabetes mellitus: In diabetic patients frequency of whorls was significantly increased, while frequency of ulnar loops was significantly decreased in cases as compared to controls. Arches, radial loops and Atd angle showed no significant difference. A-b ridge count is significantly decreased in diabetics. C line type also showed significant difference in cases and controls.\(^{17}\)

Use of dermatoglyphics to identify left handed uniqueness: Left handers have more dominant control of left handover right hand. The hand which lies closer to the mouth of fetus, determines the handedness. Leucine rich repeat transmembrane neuronal gene on chromosome 2p12 determines the handedness. Schizophrenia disease more likely to occur in left handers. Left handers dermatoglyphics pattern show increased loop, tented arch and plain whorl pattern and decreased simple arch, central pocket and double loop whorl when compared to right handers.\(^{3}\)

CONCLUSION

The dermatoglyphics plays an important role in forensic sciences as epidermal ridge patterns of hands and feet are last to decompose after death. Different ridge patterns are found in different diseases. By studying these patterns, one can evaluate the significant changes representing the diseases. Dentists may use dermatoglyphics for the early diagnosis and prevention of the diseases by observing the various ridge patterns of an individual. In future, it may serve as an early indicator to predict the future health of an individual.

REFERENCES

Platelet-rich Plasma: Is It Ready to Use?

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ABSTRACT
For over 20 years, autologous blood products, such as platelet-rich plasma (PRP) have been employed as a means to facilitate the healing process. Platelet-rich plasma has been advocated as a way to introduce increased concentrations of growth factors and other bioactive molecules to injured tissues in an attempt to optimize the local healing environment. This article reviews the basic principles involved in creating PRP and outlines the specific effects of these growth factors, both in vitro and in vivo, on periodontal wound healing.

Keywords: Healing, Platelet-rich plasma, Regeneration.


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HEALING OF TISSUES: DOWN THE LANE
The ultimate goal of periodontal therapy is not only to prevent periodontal disease progression but also to regenerate the lost dentition’s supporting structures, such as cementum, periodontal ligament, and bone to a diseased root surface where appropriate.1,2 But, at best, surgeons attempt to remove the known obstacles to healing, such as infection, instability, foreign bodies, etc.

A review of the literature related to wound healing shows that debridement and primary closure was the ‘hot topic’ of the 1950s. In the 1980s, the three seminal works by Knighton,3 Hunt,4 and Marx et al5 marked a paradigm shift by focusing attention on actively promoting healing rather than just removing the obstacles to it. First, introduced clinically by Knighton’s platelet-derived wound healing factor (PDWHF),6 and then through topical recombinant human platelet-derived growth factor bb (PDGFbb) (Regranex, Ortho McNeal) and today’s platelet-rich plasma (PRP), platelets have found to be the pivotal cells that initiate all human wound healing.

PLATELET-RICH PLASMA: WHAT IS IN A NAME?
Platelet-rich plasma has been classically (Table 1) described as ‘a volume of plasma that has a platelet count above baseline (of whole blood).7 Although this definition would suggest a pure mixture of plasma (the acellular, liquid portion of blood that contains proteins involved in the clotting mechanism as well as other bioactive molecules that play a significant role in wound repair) and platelets (and their associated growth factors and cytokines), the generic term ‘PRP’ has recently expanded to include a variety of final products. These products can vary markedly not only in the final concentration of platelets they produce but also in the amount of red blood cells and/or white blood cells that are included in the final preparation. In addition, some techniques for creating PRP actively initiate the clotting cascade as part of the process, creating a fibrin scaffold. Because, the inclusion of these additional blood components may affect the indication(s), potency, and efficacy of the final PRP product, the generic classification ‘PRP’ does not allow distinction between the different systems and protocols.8 Therefore, to more precisely delineate these various products based on their leukocyte and fibrin content, categories, such as pure PRP, leukocyte rich PRP (L-PRP), pure platelet-rich fibrin, and leukocyte- and platelet-rich fibrin have been proposed.8

METHODS OF PREPARATION
At least 16 commercial PRP preparation systems are currently available (Table 2). A sample of peripheral venous blood is drawn and immediately spun in a centrifuge to separate the erythrocytes from the platelets and leukocytes. The increased density of the erythrocytes causes them to sink to the bottom of the centrifuge tube more rapidly than do the platelets and leukocytes. Further concentration then isolates PRP from platelet-poor plasma. Commercially available PRP kits concentrate platelets in the final injectate up to 9 times the normal concentration found in whole blood. The resultant volume of PRP and the final platelet and leukocyte concentrations differ among preparation systems.9

HOW MANY PLATELETS ARE ENOUGH?
This question has been elegantly answered by the work of Haynesworth et al,10 who showed that the proliferation...
of adult mesenchymal stem cells and their differentiation were directly related to the platelet concentration. They showed a dose-response curve, which indicated that a sufficient cellular response to platelet concentrations first began when a 4- to 5-fold increase over baseline platelet numbers was achieved. Because most individuals have a baseline blood platelet count of 200,000 ± 75,000/μl, a PRP platelet count of 1 million/μl as measured in the standard 6-ml aliquot has become the benchmark for ‘therapeutic PRP.’

The importance of this knowledge is that our studies have indicated that only the aforementioned FDA cleared devices consistently achieve this therapeutic level of platelet concentration, and hence growth factor release.

**PLASMA: THE OTHER ‘P’ IN PRP**

Perhaps the most consistent component of many of the PRP products is the plasma component. Plasma, the fluid portion of blood, is a remarkable liquid containing numerous ions, inorganic and organic molecules, and many of the same proteins found in platelets. Plasma differs from serum in that plasma still contains fibrinogen as well as a number of clotting factors. Therefore, when plasma is exposed to thrombin (either by the addition of
exogenous thrombin or by coming in contact with tissue thromboplastin (also known as tissue factor), the clotting cascade is initiated and platelets are activated. The resulting formation of a fibrin clot provides a provisional scaffold for cell migration as well as a reservoir of growth factors. Although in vitro studies have documented significant differences in cell proliferation between PRP and platelet-poor plasma preparations, it is possible that the plasma component of PRP actually plays a more significant role in creating a proper local environment for tissue repair.

**Exogenous Thrombin: To Activate or not to Activate**

Platelet activation can be initiated by a number of methods, such as shear forces caused by fluid flow, contact with a variety of material including fibrillar collagen and basement membranes of cells, and thrombin. Most current PRP protocols rely on bovine or autologous thrombin with or without calcium chloride to congeal the solution and activate the platelets. Gelation of the PRP solution is necessary to localize the product (and thereby its effects) onto the area of interest without loss into the surrounding tissues. To minimize the risk of immune reaction associated with thrombin, some have used calcium chloride as an activator by itself. An alternative activator recently reported is type I human collagen. As previously mentioned, when PRP is injected into connective tissues, it comes into contact with tissue thromboplastin (tissue factor), which can activate platelets and initiate the formation of a fibrin scaffold. Therefore, the need for platelet activation with exogenous thrombin before injection is not clear.

**Mechanism of PRP-related to Growth Factors**

The growth factors secreted by the platelets (i.e. PDGFαa, PDGFbb and PDGFab) usually have two active sites and are, therefore, called dimers. They attach only to cells that have receptors to accommodate them. These receptors are on the surface membrane of the target cell (Fig. 1). The growth factor never enters the target cell; instead, it activates the membrane receptor, which has an intracytoplasmic portion and, therefore, is often termed as ‘transmembrane receptor’. Two adjacent transmembrane receptors are then brought within a critical distance of each other to activate dormant intracytoplasmic signal transducer proteins. A signal transducer protein, then detaches from the transmembrane receptor and floats in the cytoplasm toward the nucleus. In the nucleus, the transducer protein unlocks a specific gene sequence for a regulated cellular function, such as mitosis, collagen synthesis, osteoid production, etc. The significance of this process is that it explains why an exogenous application of growth factors, even in the highest concentration possible, cannot produce a sustained overreaction, such as a hyperplasia, a benign tumor, or a malignant tumor. Growth factors are not mutagenic; they are natural proteins acting through normal gene regulation and normal wound healing feedback control mechanisms.

**Effects of PRP Growth Factors on Cells Involved in Periodontal Wound Healing**

Periodontal wound healing involves gingival fibroblasts, gingival epithelial cells, periodontal ligament fibroblasts and osteoblasts, all of which are important for tissue repair and hard-tissue regeneration. A series of well-orchestrated cell—cell interactions is initiated after injury. Disruption of the vasculature as a result of injury leads to fibrin formation and platelet aggregation. Several growth factors are then released into the tissue from the platelets and from the adjacent cells after injury, including platelet-derived growth factor (PDGF), transforming growth factor-alpha, transforming growth factor-beta (TGF-beta) and insulin-like growth factor I (IGF-I). Bone and cementum may also release growth factors during wound healing (Table 3).

Periodontal and oral surgical techniques may involve use of these factors in both soft and mineralized tissues.
For example, local application of growth factors is used to promote healing, especially regeneration. Numerous studies, including some dental research, have shown that PDGF, TGF-beta and IGF-I are found in PRP and, because of their impact on wound healing, the use of these factors has led to promising results. Platelet-derived growth factor is a basic dimeric glycoprotein with two disulphide-bonded polypeptides, referred to as A and B chains. Three isoforms of PDGF are possible: AA, BB and the heterodimeric AB. All isoforms of PDGF are released after adhesion of platelets to an injured site. In vitro, all isoforms have proliferative activity on periodontal ligament fibroblasts. Platelet-derived growth factor is also chemotactic for these fibroblasts, and it promotes collagen and protein synthesis.

Insulin-like growth factor has two forms, I and II, each of which has two single chain peptides. Both forms of IGF are potent factors for survival of hematopoietic cells, fibroblasts and the nervous system. They are found in bone, and IGF-II is the most abundant growth factor in bone matrix. This form of IGF is chemotactic for periodontal ligament cells, and it has strong effects on periodontal ligament fibroblasts and protein synthesis. Insulin-like growth factor-I stimulates bone formation by proliferation and differentiation, and it is synthesized and secreted by osteoblasts. It also has dose-dependent chemotactic effects on osteoblasts.

Human patients treated with a combination of 150 mg/ml of recombinant human platelet-derived growth factor-BB (rhPDGF-BB) and rhIGF-I in a methylcellulose vehicle experienced 43.2% osseous defect fill, whereas the control group (vehicle only) had 18.5% osseous fill.

Transforming growth factor-beta is the name given to a group of homodimeric proteins involved in the formation and development of many tissues. Transforming growth factor-beta enhances collagen gel construction in vitro, and its effects are influenced by the combination of PDGF and IGF. In addition, TGF-beta stimulates biosynthesis of type I collagen and fibronectin and induces deposition of bone matrix.

In a recent review, Yao and Eriksson reported that short shelf life and inefficient delivery to target cells are major concerns associated with local administration of recombinant human growth factors. The growth factors are expensive, and many doses may be required to achieve any therapeutic effect. In light of this PRP can be used as a pool of concentrated growth factors.

Clinical Effects on Osseointegration

Osseointegration of dental implants arises from cell migration, differentiation, bone formation, and bone remodeling along the implant surface; each of these processes is platelet and blood clot dependant.

During implant placement, the blood clot, or the PRP that is placed into the drill site, coats the implant surface as well as the microgap (about 25 μm wide) that lies between the actual bone and the metal surface.

Table 4: Studies showing clinical effects of PRP with various bone substitutes

<table>
<thead>
<tr>
<th>PRP therapy</th>
<th>Researcher and year of study</th>
<th>Study protocol</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRP with autogenous bone</td>
<td>Marx et al (1998)</td>
<td>Forty-four continuity bone grafts to the mandible, placed without PRP, were assessed against 44 grafts placed with PRP at 2, 4, and 6 month maturity intervals with panoramic plain-film radiographs.</td>
<td>Investigators assessed PRP grafts to be 2.16 times more mature at 2 months, 1.88 times more mature at 4 months, and 1.62 times more mature at 6 months. These differences were statistically significant (p = 0.001).</td>
</tr>
<tr>
<td>PRP with anorganic bone mineral</td>
<td>Wiltfang et al (2003)</td>
<td>A total of 45 sinus lifts were performed, with half receiving PRP and tricalcium phosphate.</td>
<td>The authors report 8% or 10% greater new bone formation in PRP group.</td>
</tr>
<tr>
<td>PRP with organic bone matrix</td>
<td>Shanaman et al (2001)</td>
<td>Performed alveolar ridge augmentation on 3 patients, primarily using freeze-dried demineralized bone. The grafts were mixed with PRP and were protected with barrier.</td>
<td>The authors concluded that ‘the addition of PRP did not appear to enhance the quality over that reported in comparable guided bone regeneration studies without PRP’.</td>
</tr>
<tr>
<td>PRP when used alone</td>
<td>Papli and Chen (2007)</td>
<td>Compared the treatment of infrabony defects by an intrallesional graft of PRP to guided periodontal regeneration (GPR) using a bioabsorbable barrier membrane (MEM) over a 52 week period.</td>
<td>Their case series suggested that an PRP graft achieves a similar CAL gain and PD reduction to GPR using an MEM over a 52 week period.</td>
</tr>
</tbody>
</table>

Within this microgap are found the usual components: platelets, red blood cells, white blood cells, and the cell adhesion molecules of fibrin, fibronectin, and vitronectin. In this situation, the cell adhesion molecules perform the important roles of coating the implant surface and bridging the microgap between the implant surface and the bone.

The model for osseointegration demonstrates that platelets degranulate and secrete their seven growth factors. As a result, the osteoclasts and marrow stem cells along the bony walls of the drill site proliferate and migrate along the strands of fibrin and other cell adhesion molecules spanning the microgap. As they migrate along the surface of the fibrin strands, the marrow cells can pull the fibrin strands off the implant surface. As the marrow cells migrate along the fibrin starnds, they undergo differentiation and produce osteoid.

**Clinical Applications of PRP**

Different applications of PRP include sinus lift procedures, ridge augmentations, socket preservation, alveolar cleft palate repair, oral/nasal fistula repair, intrabony defects, furcation defects, jaw reconstruction surgeries, structural defects of the mandible and especially in medically compromised patients who undergo surgery have been suggested. Some clinicians also use PRP applications in soft-tissue procedures, like gingival grafts, subepithelial connective tissue grafts, etc., because of its property of increasing soft tissue healing. Platelet-rich plasma has also found its application in medicine as a treatment of skin ulcers, macular lesions, and corneal epithelial defects. Recent studies have shown that combining PRP with bone or bone substitutes present significant faster radiographic maturation and denser bone regeneration histologically. The results of few studies have been summarized in the Table 4.

**CONCLUSION**

Today’s understanding of bone science recognizes the pivotal role of growth factors in clinical bone grafting success. Platelet-rich plasma is seen as an available and practical tool for enhancing the rate of bone formation and the final quality of bone formed. Undoubtedly, all clinicians involved with bone grafting have high hopes that PRP will eventually prove to be of great benefit in bone graft healing. The conflicting results in today’s literature make it overwhelmingly evident that more research is needed before surgeons can feel confident in recommending this procedure to their patients.

**REFERENCES**

Palatoradicular Groove: A Local Factor for Local Pathology

Magesh S Kumar, RG Shiva Manjunath, Rika Singh, Anju Rana

ABSTRACT
Palatoradicular groove (PRG) is a developmental morphological defect which usually affects the maxillary incisors. These anomalies often act as funnel traps aiding plaque accumulation leading to severe localized periodontitis with or without pulpal necrosis. A thorough clinical examination with emphasis on the periodontal examination along with appropriate diagnostic aids can lead to early diagnosis and management of the tooth/teeth involved leading to longevity of the tooth/teeth concerned in the oral cavity. This review highlights about the clinical relevance and the different treatment modalities available to treat this anatomical anomaly.

Keywords: Funnel traps, Localized periodontitis, Maxillary incisors, Palatogingival groove, Palatoradicular groove.

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INTRODUCTION
Periodontitis is a multifactorial disease with microbial dental plaque as the initiator of periodontal disease and is one of the two major dental diseases that affect human populations worldwide at high prevalence rates. Dental plaque or microbial biofilms are matrix enclosed bacterial population adherent to each other and/or to surfaces or interfaces. However, the manifestations and progression of periodontitis is influenced by a wide variety of determinants and factors, including subject characteristics, social and behavioral factors, systemic factors, genetic factors, microbial composition of dental plaque, tooth level factors.

Local factors can be defined as anything that influences the periodontal health status at a particular site or sites with no systemic effects. These local factors can be any irregularities in root anatomy, subgingival restorations margins, overhanging restorations and these factors can enhance bacterial adhesion to tooth/root surfaces and allow the growth of subgingival plaque which can alter changes in the local environment upsetting the balance between health and disease resulting in periodontal destruction. Though periodontitis can be prevented by proper hygiene measures and professional care, it is also important to control important risk factors for the disease. This forms the basis of the new approach proposed by the World Health Organization (WHO) for management of non-communicable chronic diseases. So the new paradigm for managing periodontal diseases is therefore in modifying the risk factors. These local factors are modifiable.

One of the local factor which is often been related to localized destruction of periodontal tissue and endodontic complications is palatoradicular groove (PRG). Palatoradicular groove is a morphological defect associated with maxillary central incisors and/or lateral incisors. These defects usually occur on the lingual surfaces of the midpalatal, mesial or distal region of the tooth, but can also be seen on the buccal aspect of maxillary incisors.

History and Etiopathogenesis
Palatoradicular groove was first described as a malformation which occurred during embryo formation, later this anomaly was described as a groove which was located on the palatal surfaces of the maxillary incisors. The exact etiology of this defect is still debatable. It is believed that the radicular groove represents the mildest form of dens evaginatus and there is minimal infolding of the enamel organ and epithelial root sheath of Hertwig during odontogenesis. Many other believe that this anomaly may result when there is an attempt of the body to form another root on the affected tooth. Palatoradicular groove can also occur due to the late onset of mineralization of the crown of the maxillary lateral incisor making the tooth bud more susceptible to the infolding.

This malformation is also described in dental literature as a palatal gingival groove, radicular developmental anomaly, distolingual groove, radicular lingual groove, and syndesmo-corono radicular tooth. The palatal groove usually begins in the central fossa, cross the cingulum and extends to varying distances...
and directions down the root. The distance traversed by
the groove also vary in distance the mild ones usually
terminate on the crown or at the cementoenamel junction
(CEJ), as when compared to the moderate grooves which
continue apically along the root surface.11

Prevalence/Incidence

A prevalence of 12 to 21% in both lateral and central
maxillary incisor in collections of teeth dating back to
prehistoric to medieval eras.21 In a study of 500 teeth,
3% of incisors presented with palatal groove.20 In a
sample of 633 maxillary lateral incisors, it was reported
palatal grooves extended up to the apex in 0.47% of the
upper lateral incisors and the same 0.47% of incisors the
groove did not extend up to the apex.15 Palatoradicular
grooves were present in 8.5% of the teeth in 531 subjects
studied, but the prevalence of incisors with a palatal
groove extending to the apex was only 2.3%.22 In a large
sample of 3,021 teeth, the groove was detected in 4.6%
of cases 10. An incidence of 2 and 2.6 % was found in 500
central and 421 lateral incisors respectively.23 A high of
18% incidence of palatoradicular grooves was reported
in a Chinese population.24

Clinical Relevance

Diagnosis of the (PRGs) sometimes presents a challenge to
the clinicians, when a patient presents with myriad signs
and symptoms relating to a true localized periodontitis or
a true endodontic problem or a combination of the both.25
Clinically, the region adjacent to the groove will reveal
inflamed, edematous or cyanotic gingiva, with abundant
plaque and calculus deposits (Figs 1 and 2). These
grooves act as funnels leading to entrapment of plaque
and thus initiating a localized inflammatory process
around the groove. The lesion is limited to the gingiva
as long as there is no breach in the epithelial attachment.
Once the attachment is breached a periodontal pocket
occurs which further adds to the difficulty in plaque
removal by the patients leading to a more deeper pocket
sometimes extending up to the apex with subsequent
pulpal involvement either through the apex or via the
accessory canals leading to localized periodontitis and
pulpal necrosis (Fig. 3). This may present a challenging
situation in terms of diagnosing and management of
these conditions. Emphasis should be made for a need
of thorough clinical and periodontal examination of the
tooth, which can lead to an early diagnosis of PRG, so that
a proper treatment of the tooth can be carried out early
thereby improving the prognosis of the involved tooth.26
Radiographically the groove may present as a parapulpal
lines on the radiographs.23

Classification of Palatoradicular Groove27

Palatoradicular grooves are classified into simple PRG
and complex PRG simple PRGs do not communicate with
the pulp and represents a partial infolding of Hertwig’s
epithelial root sheath (HERS), while the complex PRGs
communicate directly with the pulp and the groove
extends the length of the root.

MANAGEMENT

The prognosis and management of these PRGs depends
on the apical extension of the groove, the extent to which
the periodontal involvement is involved and the condition
of the pulp, as well as the chronicity and adequacy to
plaque control measures.

Various authors have suggested different methodologies of
treatment. Most of the cases when there is
only periodontal involvement without endodontic comp-
ications as in mild forms, conservative treatment like
scaling and root planing, along with flap curettage is
often advised,25,28 the groove is often sealed with glass
ionomer cement,25 composite material or amalgam29
and calcium sulfate.19,30 In moderate form of periodontal
involvement with endodontic complications, the line of
treatment usually endodontic treatment followed by a

![Fig. 1: The region adjacent to the groove (lateral incisor distal aspect) reveals inflamed, edematous or cyanotic gingiva](image)

![Fig. 2: The groove is filled with plaque and calculus (mesial of lateral incisor)](image)
Palatoradicular Groove: A Local Factor for Local Pathology

When there is significant extension of the groove along the root surface up to middle third, then surgical procedures with placement of osseous grafts, barrier membranes and enamel matrix derivatives are often indicated. A combination of endodontic, intentional replantation, without/with regenerative therapy has also been shown to be effective in managing these defects. Autologous blood products like platelet rich plasma can also be used as a mode of regeneration of the lost attachment apparatus.

Prognosis is deemed to be poor when there is extension of the groove till the root apex, severe bone loss and/or both. Extraction of the involved teeth is advised in these situations (Fig. 4).

SUMMARY AND CONCLUSION

Palatoradicular grooves in maxillary anteriors are often implicated as an initiating and progressive factor in the etiology of localized periodontitis and irreversible pulpitis. The clinicians must be very alert in diagnosing PRGs so that the patients may be educated about the possibility of future complications as well as maintenance of proper oral hygiene. Secondly with timely diagnosis proper management of the affected teeth can be instituted providing longevity of the involved tooth.

REFERENCES


Use of Laser in Prosthodontics

Sankey Kumar Baidya, MK Singhal, Alok Kumar, Chandana Nair, Shipra Tripathi

ABSTRACT
Lasers were introduced into the field of clinical dentistry with the hope of overcoming some of the drawbacks posed by the conventional methods of dental procedures. A variety of studies on the potential applications of lasers in dentistry have been conducted. Many applications, like computer aided design and rapid prototyping technology, and study of occlusion in complete dentures using three-dimensional (3D) laser scanner have been developed. The applications of laser range from fixed prosthodontics to treatment of dentinal hypersensitivity to surface treatment of base metal alloys. Nowadays, it even extends to the fields of dental implantology and maxillofacial prosthodontics.

Keywords: Complete denture, Dental implants, Dentinal hypersensitivity, Laser, Maxillofacial prosthesis.


INTRODUCTION
Laser is an acronym for light amplification by stimulated emission of radiation. They are heat producing devices converting electromagnetic energy into thermal energy. The characteristic feature of a laser depends on its wavelength. The wavelength of a laser affects both the clinical applications and design of laser. The wavelength used in general medicine and dentistry generally range from 193 to 10,600 nm, representing a broad spectrum from ultraviolet to the far infrared range.

The most earlier lasers used in dentistry are the CO₂ and Nd:YAG. Since, the beam of both lasers falls in the far infrared range on the spectrum, they are not visible, therefore, these lasers often use Quartz fiber incorporating a 630 nm coaxial helium-neon laser into the device to act as an aiming beam and facilitate use.

HISTORY OF LASERS
Theodore Harold Maiman is generally given credit for building the first working ruby laser and operating it for the first time on May 16, 1960 at the Hughes Research Laboratory in Malibu, California. MASER a microwave amplifier by Charles H Townes, P Gordon et al became the basic principle for laser pumping. This set the stage for a ‘snowball effect’ which would lead to the development of many laser systems, which we utilize in healthcare today.

Some reports on the use of the laser also support the possibility of treating malignant oral diseases in early stages (e.g. T1N0 carcinomas) with excisional biopsies.

TYPES OF LASER
Dental lasers are divided into two basic categories as follows:
1. Those, which work solely on noncontact mode either focused or defocused, e.g. CO₂ and erbium laser.
2. Those that work either in contact or noncontact mode, the contact mode being focused and the noncontact mode being defocused. This group includes lasers given by fiber optics, e.g. argon, Nd:YAG and Ho:YAG.

Focused mode: The focused mode is when the laser beam hits the tissue at its focal point or its smallest diameter and the diameter in turn is dependent upon the lens used. Most CO₂ lasers have lens that can focus the beam to a spot size ranging from 0.1 to 0.35 mm or larger. This focused mode is also called as cut mode.
Defocused mode: The other mode is called as defocused mode in which moving the focal spot away from the tissue plane defocuses the beam, and thus the beam size that hits the tissue plane has a greater diameter thus, covering a wide area of the tissue to be vaporized.4

Based on Power

High-power Lasers (Hard, Hot)

These lasers increase tissue kinetic energy and produce heat. As a result, they leave their therapeutic effects through thermal interactions including necrosis, carbonization, vaporization, coagulation and denaturation. These lasers usually have an output power of more than 500 mW.5

Intermediate-power Lasers

These lasers leave their therapeutic effects without producing significant heat. To shorten treatment period length and to accelerate the therapeutic effect in some cases, low-power lasers are replaced by intermediate lasers with output powers ranging from 250 to 500 mW.5

Low-power Lasers (Soft, Cold)

These lasers have no thermal effect on tissues and produce a reaction in cells through light, called photobiostimulation or photobiochemical reaction. Output power of these lasers is less than 250 mW. The critical point that differentiates low-power lasers from high-power ones is photochemical reactions with or without heat. The most important factor to achieve this feature in lasers is not their power but the power density per cm². If the density is lower than 670 mW/cm², it can mimic stimulatory effect of low-power lasers without any thermal effects.6

Use of Laser in Prosthodontics

A. Fixed Prosthetics/Esthetics7

- Crown lengthening
- Soft tissue management around abutments
- Osseous crown lengthening
- Troughing
- Formation of ovate pontic sites
- Altered passive eruption management
- Bleaching
- Veneer removal
- Tooth preparation for veneers and full coverage crowns and bridges8
- Removal of carious lesion and faulty composite restorations before placement of final restorations
- Crown fractures at the gingival margins enamel and dentin etching

B. Implantology

- Second stage uncovering
- Implant site preparation
- Peri-implantitis

C. Removable Prosthetics7

- Tuberosity reduction
- Torus reduction
- Soft tissue modification
- Epulis fissurata
- Denture stomatitis
- Residual ridge modification
- Treatment of flabby ridges
- Vestibuloplasty
- Sulcus deepening
- Frenectomies
- Osseocementy during tooth/root extraction or ridge recontouring
- Treatment of soft tissue and hard tissue undercuts

D. Laser Applications in the Dental Laboratory2

- Laser titanium sintering
- Laser ablation of titanium surfaces
- Laser assisted hydroxyapatite coating
- Laser welding of titanium components of the prostheses

E. Lasers in Maxillofacial Rehabilitation2

- Planning the shape and position of the prostheses
- Three-dimensional acquisition of optical data of the extraoral defects

Advantages of Laser over Other Techniques8

- It is painless, bloodless that results in clean surgical field, and fine incision with precision is possible
- There is no need for anesthesia if at all anesthesia has to be administered, then it needs to be used minimally only
- The risk of infection is reduced as a more sterilized environment is created as the laser kills bacteria
- No postoperative discomfort, minimal pain and swelling, generally does not require medication
- Superior and faster healing, offers better patient compliance.

Disadvantages of Lasers8

- Lasers cannot be used to remove defective crowns or silver fillings, or to prepare teeth for bridges
- Lasers cannot be used on teeth with filling already in place
- Lasers do not completely eliminate the need for anesthesia
Lasers treatment is more expensive as the cost of the laser equipment itself is much higher.

CONCLUSION
Lasers have become a ray of hope in dentistry. When used effectively and ethically, lasers are an exceptional modality of treatment for many clinical conditions that dentists treat on a daily basis. But lasers have never been the ‘magic wand’ that many people have hoped for. It has got its own limitations. If a clinician decides to use a laser for a dental procedure, he or she needs to fully understand the character of the wavelength being used, and the thermal implications and limitations of the optical energy. Lasers the upcoming new technology replacing the shortcomings of the conventional methods have its own disadvantages, limitations and risks. All the risks can increase in magnitude due to lack of knowledge about lasers.

REFERENCES
Controversy in the Management of N0 Neck involving Carcinoma of Head and Neck

Shouvik Chowdhury, Sunil Kumar Mall, Himanshu Pratap Singh, Arijit Sarkar, Atul Joshi

ABSTRACT

There is still no consensus on the treatment of the clinically negative neck in oral cancer patients. The aim of this review was to assess a possible benefit of elective neck dissection in oral cancers with clinical N0 neck. A comprehensive search and systematic review of electronic databases was carried out comparing elective neck dissection to therapeutic neck dissection (observation) in oral cancer patients with clinical N0 neck. Both clinical staging and routine pathologic staging underestimate the presence of nodal metastases. Staging with either sentinel node biopsy alone or sentinel biopsy assisted elective neck dissection showed promise in the management of the N0 neck by identifying patients with micrometastases. However, elective selective neck dissection is an effective but not adequate therapeutic procedure, and postoperative adjuvant radiotherapy and chemotherapy have to be considered for all pathologically positive necks.

Keywords: Clinically negative node, Elective neck dissection, Head and neck, Squamous cell carcinoma.

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Conflict of interest: None

INTRODUCTION

The most predominant location in head and neck region for primary malignant tumors are oral cavity and more than 90% cancer consists of squamous cell carcinoma. It has a high propensity for early and extensive lymph node metastases. Therefore, clinicians for cancers of the oral cavity and pharynx have to regard regional metastasis as most important. Advanced squamous cell carcinoma of the oral cavity has regional metastasis frequently, and even in small tumors (T1 or T2) has a relatively high propensity of regional lymph node metastasis. The five-year relative survival rate of patients who present with tumors localized at the primary site without dissemination to regional lymph nodes is 82% (SEER, Oral cancer statistics, http://seer.cancer.gov/statfacts/html/oralcav.html). On the other hand, once dissemination to regional lymph nodes takes place, the survival rate reduces to nearly 50%. Historically, the management of the clinically negative (N0) neck has been controversial. Since its description in 1906 by Crile and its routine use by Martin, radical neck dissection was the main therapy for any cervical lymph node metastases from head and neck squamous cell carcinoma. Researchers have reported that 30% of oral cancer patients with clinical N0 neck harbor occult metastases, depending on the size and site of the primary tumor and the histological diagnostic methods. However, the greatest challenge faced by head and neck oncologists and surgeons is the correct identification of the subset of these patients without cervical nodal micro metastases who do not require elective neck treatment. Clinical palpation of the neck is grossly inadequate. Available radiological investigative tools have shown some improvements in the detection of neck metastasis but sensitivity ranged between 70 and 80%. Although oral carcinoma is a locally aggressive disease with a great tendency for loco-regional and distant metastasis, the reality is that some patients with a clinical N0 neck do not actually have cancer cells in the cervical lymphatics. Treating these necks may incur unnecessary costs, prolongation of hospital stay and causation of avoidable morbidity. However, when a clinical N0 neck with actual micro metastases is not included in the management plan for these patients, the implications are poor treatment outcome with increased morbidity and mortality rates. Currently, the treatment dilemma that most head and neck oncology surgeons face is the treatment of the N0 neck in oral cavity squamous cell carcinoma. An analysis of randomized controlled trials could help to answer questions regarding the possible benefit of elective neck dissection. This article is, therefore, aimed at systematically reviewing the available literature and carry out a meta-analysis on the existing
randomized controlled trials which compared elective neck dissection with therapeutic neck dissection in oral carcinoma with clinical N0 neck.

Some of the questions that arise when treating an N0 neck in squamous cell carcinoma of the oral cavity are:

- What are the noninvasive or invasive modalities to assist in diagnosing cervical lymph node metastasis?
- Should the neck be treated now or observe?
- Are there prognostic factors that can guide decisions on whether or not to treat the neck?
- What modality should be used to treat the neck?
- Is there an optimal surgical approach to treat the neck?

**Proposed Treatment Options**

The N0 neck can be treated electively or can be carefully observed (wait-and-see), and the decision can be made from each own clinical experience. Three treatment options are available:

- Observation with therapeutic neck dissection once regional metastases become apparent (wait-and-watch)
- Elective neck dissection
- Elective neck irradiation

These multiple treatment options, along with different treatment modalities available for the primary cancer, make the neck treatment of early-stage oral cavity squamous cell carcinoma controversial. In a retrospective study of 891 patients with oral cavity squamous cell carcinoma, it was reported that the disease-specific survival rate for patients with N0 disease was 58.7%, compared with 39.4% for patients with N+ disease, and patients with nodal disease had significantly worse 5 years disease survival rates than with N0 disease. In addition, the presence or absence of occult lymph nodes is a major prognostic factor for survival in patients with clinically negative cervical lymph nodes. The incidence of occult disease ranges from 21 to 42%. In presence of nodal metastases, the important effect of therapeutic neck dissection in the prognosis of head and neck cancer patients is worth mentioning. However, the role of elective neck dissection has been a matter of discussion. Patients with clinically negative nodes (cN0) may still harbor occult metastasis, although advances in imaging techniques, such as computed tomography (CT), magnetic resonance imaging (MRI), ultrasound sonography (US), and positron emission tomography have increased the accuracy of nodal metastases. The National Cancer Comprehensive Network’s (NCCN) adopted practice guidelines have recommended elective neck dissection for clinical N0 cancer of the oral cavity, oropharynx, hypopharynx and supraglottic larynx (NCCN, 2011). These guidelines apply to the performance of elective neck dissections as part of treatment of the primary tumor. Elective neck dissection is prefers due to less morbidity of supraomohyoid neck dissection (SOHND) compared to classical radical neck dissection. For primary tumors in the oral cavity the regional lymph nodes at highest risk for early dissemination by metastatic cancer are limited to levels I, II, and III in the supraomohyoid triangle. Skip metastasis to levels IV and V in the absence of metastatic disease at levels I, II, or III is exceedingly rare compared to radical neck dissection. Supraomohyoid neck dissection reduces morbidity, including spinal accessory nerve disorder which results in diminished or absent function of the sternocleidomastoid muscle and upper portion of the trapezius muscle, and reduces cosmetic deformity. In addition, SOHND is considered as effective as comprehensive procedures for staging the clinically negative neck, when the neck is treated electively. It is intrinsic in the philosophy of a preventive treatment, to make it the less morbidity possible without losing oncologic results. However, this elective policy results in overtreatment of the neck, when the neck actually has no involved nodes. Approximately 20% of patients who received SOHND had a shoulder pain even with conserving the accessory nerve. Such overtreatment should be avoided when patients have no involved nodes in the neck. In another study, it was found out that sonographically guided fine-needle aspiration cytology to be significantly more accurate than palpation, CT, or MRI for the assessment of N0 neck.

**Prognostic Factors for the Management of N0 Neck**

**Tumor Size**

Five years survival rates for oral squamous cell carcinoma are 91% for T1 disease, 63% for T2, 60% for T3 disease. Cervical lymph node metastasis was seen in 14% patients with T1 tumors, 37% in with T2, and 57% in tumors greater than 4 cm in diameter.

**Perineural Invasion**

Tumor invasion in perineural sheath or epineurium is called perineural invasion. Regional metastatic disease developed in 71% of N0 patients who had perineural invasion vs 36% of N0 patients who did not have invasion. It was also showed that in the presence of perineural invasion 2-year survival decreased from 82 to 52%.

**DNA Ploidy**

Bone invasion occurred in 68% of patients with DNA nondiploid tumors, vs 22% of patients with DNA diploid tumors. Nodal metastases occurred in 54% of DNA nondiploid and 19% of DNA diploid tumors.
Tumor Thickness

Studies showed that risk of cervical metastasis increased from 5.9% for tongue carcinomas less than 5 mm thick to 64.7% for tongue carcinomas more than 5 mm thick.

Extracapsular Spread

The presence of extracapsular spread reduces survival in oral squamous cell carcinoma. The authors recommended adjuvant therapy in the presence of extracapsular spread.

DECISION ANALYSIS

The decision tree is based on an analysis of the utility of the management options taking into account the incidence of node involvement, disease control rates and complications of treatment. N0 necks should be treated electively when the occult metastatic rate is more than 20%.

Calculation of the Threshold for the Treatment of N0 Neck

The treatment threshold between elective neck dissection and observation was estimated with three (a–c) probabilities of survival; a = the curable probability (5 years survival rate) of the patients received elective neck dissection with no neck recurrence, b = the curable probability of the observed patients with late neck metastasis, c = the curable probability of the observed patients with no neck recurrence.

With the sensitivity analysis, the treatment threshold can be calculated through the following:

$$Rx = \frac{c - 0.97a}{0.00376 - 0.0776a - 0.94b + c}$$

When clinicians calculate their own three probabilities (a – c) of being cured, they can estimate threshold for treatment of N0 neck using this formula. The formula will be put to practical use and will estimate the current threshold.1

Observation vs Elective Neck Treatment

There is a great controversy regarding the optimal therapy for clinically negative necks. Another argument was that with close follow-up, any cervical metastasis can be detected early and then treated with adequate therapy. Moreover, the occult metastatic rate to the neck from oral cavity cancer is 34%. It was argued that, nearly two thirds of the patients would be exposed to the morbidity of a neck dissection unnecessarily. According to decision tree analysis, it was concluded that observation is the preferred option when the probability of occult metastasis is less than 20% and elective neck treatment is preferable when the probability of occult metastasis is greater than 20%. In squamous cell carcinoma of the oral cavity the sites with less than 20% occult metastatic rate to the neck are T1/T2 lip carcinomas, T1/T2 oral tongue carcinomas that are less than 4 mm thick, and T1/T2 floor of mouth cancers less than or equal to 1.5 mm thick.5 In another study, it was seen that patients who had undergone resection plus elective neck dissection, less recurrences developed than in those who had resection of the primary alone and disease free survival rate was 72% for elective neck treatment, vs 49% in the patients who had resection of the primary alone and also decreases cervical lymph node metastasis significantly.5 Another study confirmed that selective neck dissection of levels I to III remains the most important diagnostic tool in clinically N0 squamous cell carcinoma of the oral cavity.6

Another study suggested that elective neck dissection should be performed for early stage tongue cancer with no clinical nodal metastases.7 A study of the Memorial Sloan-Kettering Cancer Center demonstrated that despite close follow-up, patients under observation rather than in elective treatment, showed advanced neck disease, and 77% cN0 at the time of the initial diagnosis had evidence of extracapsular spread.8

Another study concluded that occult lymph node metastases are present in a high percentage of patients with supraglottic carcinoma and clinically N0 necks emphasizing the need for an elective treatment of the neck. On the other hand, this study does not support the use of routine bilateral neck dissection in the treatment of all lateral supraglottic carcinomas involving N0 neck. The rare involvement of the contralateral side of the neck in lateral lesions suggests that bilateral neck dissection may be better reserved for cases in which the probability of occult metastases is likely; either central or bilateral tumors and lateral tumors with clinically positive nodes in the ipsilateral side of the neck.9 In another study, it was concluded that there was no survival advantage gained by performing neck dissection in the clinically negative neck. However, a trend toward reduced regional failure with neck dissection must be balanced in supraglottic carcinoma by the increased potential for complications and fistulae.10

Elective Neck Dissection vs Elective Neck Irradiation

Once the decision to treat N0 neck has been made, there are two possible treatment modalities. The question arises whether to irradiate the neck or to perform a surgical lymphadenectomy. If primary radiation therapy is used, neck irradiation can be performed. To remove the primary tumor, an elective neck dissection can be performed. Obviously, the risks of both procedure need to be considered on an individual basis for each patient.5
According to one study, ipsilateral level I to III neck dissection was an adequate diagnostic procedure for staging of the N0 neck of early oral tongue carcinoma.  

**Elective Neck Dissection—What is the Surgery of Choice?**

Levels I, II and III lymph nodes are at highest risk of occult metastases from oral cavity. More recently, it has been demonstrated that level IV need be dissected only if there are suspicious nodes in level II or III. In a multi-institutional study, the author concluded that it is safe and appropriate for dissection of sublevel IIB and level IV from the elective neck dissection performed for laryngeal cancer with N0 neck. This practice will reduce both operating time and morbidity, particularly accessory nerve dysfunction, without compromising the result. Occult lymph node metastases are present in a high percentage of patients with supraglottic carcinoma and clinically N0 necks emphasizing the need for an elective treatment of the neck. Analysis of the distribution of lymph node metastases in patients with squamous carcinoma of the larynx revealed a marked preference for levels II, III, and IV in which levels I and V are rarely involved. Based on these observations, lateral neck dissection has been recommended in patients with necks staged as N0.

**Combined Treatment Modality**

Head and Neck Society guidelines recommend the use of postoperative radiation therapy when there are perineural, intravascular, and intralymphatic tumor spread, positive microscopic margins, more than two histologically positive lymph nodes, multiple positive lymph nodes, extracapsular spread, and DNA nondiploid tumors.

**Role of Sentinel Node Biopsy**

Sentinel lymph node is the first node to which a tumor will metastasize via the lymphatics. The technique is based on the premise that lymphatic flow from the primary tumor travels sequentially to the sentinel lymph node, or first-draining lymph node or nodes, and then on to the remaining regional lymph nodes. Although it has been used in a number of cancers, the concept has been mainly applied to malignant melanoma and breast cancer.

Sentinel node biopsy is being popularized as a staging tool for mucosal head and neck cancer. Reliable means of detecting lymph node disease is by pathological examination of the lymph nodes. Physical examination of the neck is an unreliable means to assess nodal involvement along with radiological imaging techniques. Initially, sentinel node biopsy were performed in the context of an elective neck dissection in order to determine whether the pathology of the sentinel node confirmed the pathological status of the neck dissection using Hematoxylin and Eosin. Techniques employed to detect sentinel nodes involved the use of radiocolloid injection, preoperative lymphoscintigraphy, intraoperative use of a gamma detecting probe and intraoperative use of blue dye, use of sentinel node biopsy to stage the N0 neck with a combination of the above techniques showing identification and sensitivity rates of over 90%. This initial work confirmed that sentinel node biopsy could be used to stage the N0 neck. It also confirmed that the patients who would benefit the most were T1/2 N0 patients, N0 patients with midline tumors, and N+ patients in whom the contralateral N0 neck was staged with sentinel node biopsy. Sentinel node biopsy alone provides a staging tool that is minimally invasive and causes minimal morbidity and allows additional pathological staging. In another study, it was found out that floor of mouth tumors were the only group in which the sentinel node did not reflect the staging of the rest of the nodal basin. It would seem that the close proximity of the floor of mouth to the draining nodal basin leads to difficulty in both identifying and harvesting the sentinel node. Even with use of techniques, such as software masking and lead shields this remains a challenge. In matter of tracer selection in a study, it was considered that radioisotope method has some advantages compared with the blue dye method due to broad distribution of sentinel nodes specially bilateral nodes. Sentinel nodes are often located in the deep layer, which is also difficult to detect by color and radioisotope method is also valuable for detecting nodes in unusual sites.

**CONCLUSION**

It may not be possible to set the incidence of occult metastases to zero. More sensitive parameters or markers associated with the presence of nodal metastasis are encouraged to be developed. For the current management of N0 neck the significant points clinicians has to comprehend their own threshold between observation and elective neck dissection. For that, it is necessary to estimate the occult metastasis and probabilities of survival. Then, the best policy of the management of clinical N0 necks will be able to be control and determine. Extended operations with less morbidity in surgical oncology have been pursued to improve the outcomes. However, these extended operations are not necessarily wise. In squamous cell carcinoma of oral cavity, elective neck dissection does not also seem to be superior to a wait and watch policy, and vice versa. However, the N0
necks might be conserved more frequently without the decline of survival by means of the improvement of nodal assessment and the higher salvage rate of late lymph node metastases.

REFERENCES


Management of Amelogenesis Imperfecta

Meenu Bhola, Neeru Singh, Virinder Goyal, Shikha Dogra

ABSTRACT

Management of a patient with amelogenesis imperfecta is a challenge for clinician. The treatment options vary considerably depending on several factors, such as the age of the patient, socioeconomic status, periodontal condition, loss of tooth structure, severity of the disorder, and most importantly the patient cooperation. Complete oral rehabilitation may involve adhesive porcelain veneers, dentine bonded crowns and eventually full coverage gold, porcelain bonded to metal or all ceramic crowns.

Keywords: Amelogenesis imperfecta, Amelogenin, Enamelin, Enamelysis, Kallikrein.


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INTRODUCTION

Amelogenesis imperfecta is a developmental disturbance that interferes with normal enamel formation in the absence of a systemic disorder. In general, it affects all or nearly all of the teeth in both the primary and permanent dentitions. Amelogenesis imperfecta may be inherited by X-linked or sporadic inheritance. The different clinical manifestations of amelogenesis imperfecta have a specific gene anomaly associated with each phenotype. Specific mutations proven to cause amelogenesis imperfecta include: amelogenin (AMELX), enamelin (ENAM), kallikrein 4 (KLK4), enamelysis (MMP-20) and FAM83H.

Amelogenesis is a two-staged process where a protein rich matrix is initially laid down during the secretary phase, followed by the mineralization phase where the proteins are replaced by hydroxyapatite crystals. This results in the highly mineralized enamel structure. Amelogenesis imperfecta has been classified into four types: hypoplastic, hypomaturation, hypocalcified, and hypomaturation-hypoplastic with taurodontism. Each type has subtypes differentiated by mode of inheritance.

Enamel hypoplasia results in a decreased quantitative enamel formation. The enamel in hypocalcification appears normal but poorly mineralized while hypomaturation results in an abnormal mineralization in the final stages of tooth formation. The most common form, the hypoplastic type, is deficient in normal enamel. The crowns of the teeth appear blanched, snow-capped, yellow-brown, pitted or grooved. Radiographic examination usually shows a full complement of teeth, but the crowns of the teeth either have very thin enamel or lack enamel completely. Dental radiography in form of orthopantomogram (OPG) and full mouth intraoral radiographs plays a vital role in diagnosing the difference in density of enamel in amelogenesis imperfecta patients and normal patients along with dentin thickness, pulp canal and root length. This case report represents the complete oral rehabilitation of patient with amelogenesis imperfecta.

CASE REPORT

A 16-year-old male patient (Fig. 1) reported to the Department of Pedodontics and Preventive Dentistry, Dasmesh Institute of Research and Dental Sciences, Faridkot, with a chief complaint of discolored teeth since childhood (Figs 2A to C) and associated intermittent pain in right and left lower back teeth since 3 to 4 months. Pain was dull and nonradiating. Patient had undergone a dental

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Fig. 1: Patient’s preoperative photograph
treatment from local dentist wrt same teeth few months back. Patient resided in a nonfluoridated area since birth. His natal, postnatal and medical histories were not significant. His mother and maternal aunt also suffered from the same condition. Patient had similar appearance of teeth in primary dentition.

On intraoral examination, it was found that whole permanent dentition exhibited yellowish brown discoloration without superficial chipping away of enamel. 36, 46 and 47 were restored by previous dentist. Radiographic examination revealed inappropriate root canal treatment with overhanging margins of restorations wrt same teeth (Fig. 3). Mesioangular impaction wrt 48 was present. Dental caries wrt 35, 37 and 45 were present. A provisional diagnosis of hypoplastic amelogenesis imperfecta was proposed.

The complete oral rehabilitation included oral prophylaxis, topical fluoride application restorations wrt 35, 37, 45, composite veneering of all maxillary and mandibular anterior teeth (Figs 4 and 5). Retreatment of 36, 46, 47 was done as patient had pain in previously root canal treated teeth (Fig. 6). Patient again reported with
sensitivity and pain wrt 35, 37 and 47, so root canal treatment was also carried out in the respected teeth. Extraction of impacted mesioangular 48 was done. Esthetic rehabilitation of 35, 36, 45 and 46 was done with porcelain fused to metal crowns (Fig. 5). Follow-up revealed a healthy and a satisfied patient after the treatment (Fig. 7).

**DISCUSSION**

Reversible and noninvasive treatment with composite resin should be considered before the more destructive treatment options. The use of composite resins allows restoration of esthetics, which is most important to the patient while preserving tooth tissue. Clinicians often avoid using composite resins, as they are susceptible to staining and technique sensitive. Staining can be effectively managed by regular polishing of the restorations. If necessary the surface layer can be removed and the restoration with a new surface layer without causing further damage to the underlying tooth structure. If the composites fracture or chip they can also be repaired easily without the need for removing the whole restoration. Composite resins should, therefore, be considered as the initial restorative material of choice for all patients, especially when the patient is in their late teens and early twenties, as a medium term option. When they start to repeatedly fail or the maintenance burden becomes too great the treatment could progress to more invasive techniques. This may involve adhesive porcelain veneers, dentin bonded crowns and eventually full coverage gold, porcelain bonded to metal or all ceramic crowns.

**CONCLUSION**

Rehabilitation of patients with amelogenesis imperfecta requires careful planning with the most important factor to consider being the age and cooperation of the patient. Management of these patients through childhood and the early teens is mainly focused around counseling, prevention and preservation of the deciduous, mixed and adult dentition.

**REFERENCES**

Mucous Retention Cyst on Lower Buccal Mucosa

Mudit Mittal, Pallavi Vashisth, Sathyajith Naik, Swati Tripathi

ABSTRACT

A 12-year-old male patient reported to the department of pediatric dentistry with translucent swelling on right lower buccal mucosa. The swelling was nontender and painless. The history was nonsignificant. Fine needle aspiration cytology (FNAC) was performed which showed increase in amylase and protein content. Excisional biopsy with complete removal was performed for the lesion. The histopathological examination was conclusive of mucocele. Patient was recalled for examination. On 3 and 6 months follow-up, patient showed progressive healing.

Keywords: Cysts, Extravasation, Marsupialization, Mucocele.

INTRODUCTION

A mucocele is a benign, painless, dome-shaped, soft-tissue mass that results from trauma or obstruction of the salivary gland ducts. The lateral aspect of the lower lip is the most common site of occurrence. However, other sites, including the upper lip and the buccal mucosa, can also be affected.1 The clinical appearance of a mucus cyst is a distinct, fluctuant, painless swelling of the mucosa.2 Mucoceles typically present as single, recurrent, painless, well-circumscribed and bluish nodules.3 The swelling of mucocele has to be distinguished from other selling like oral hemangioma, oral lymphangioma, lipoma, and soft-tissue abscess.

CASE REPORT

A 12-year-old male patient presented to the department of pediatric dentistry with a 2-month history of a 3 × 3 cm solitary, red-colored, translucent swelling lower side of cheek. The swelling was smaller in size earlier and has increased gradually.

Examination

Solitary, well-defined, translucent swelling present on right lower buccal mucosa which was soft, fluctuant and nontender on palpation and painless (Fig. 1). The patient had no family history of similar lesions and had no previous relevant medical history, including no history of local trauma or previous surgeries on that site.

Investigations

Fine needle aspiration cytology (FNAC) was done, and 1 ml of thick, viscous, sticky, and blood-mixed mucus secretion was collected and sent for chemical analysis which showed increase in amylase and protein content. A final diagnosis was formulated as mucocele from the clinical features, and investigation (chemical analysis, excisional biopsy). The histopathological examination showed a circumscribed cavity lined by granulation tissue, compressed fibrous connective tissue and fibroblasts. The connective wall shows infiltration of abundant number of polymorphonuclear leukocytes, lymphocytes and plasma cells, which lead to the diagnosis of mucocele (Figs 2 and 3).

Differential Diagnosis

The various differential diagnoses are Blandin and Nuhn mucocele, oral hemangioma, oral lymphangioma, lipoma, and soft tissue abscess. Lipomas and tumors of minor
salivary glands present no fluctuation while cysts, mucoceles, abscess and hemangiomas do. Mucoceles are mobile lesions with soft and elastic consistency depending on how much tissue is present over the lesion. Fibromas vary in consistency from soft to very firm. They are the most common intraoral soft tissue lesion, and are seen most frequently on the lips (no distinction between upper and lower lips). Lipomas, neoplasms consisting of mature adipose tissue, are uncommon in the oral cavity, but can occur on the lips. However, many lipomas are soft and fluctuant, so when this lesion does occur, it is commonly mistaken for traumatic fibroma or mucocele. The lower lip is also the most common intraoral site of squamous cell carcinoma; however, unlike the previously mentioned lesions, this one presents with variations of white and red crusting and ulceration. Salivary duct cysts occur in the minor salivary glands of the lip, but only rarely. This type of cyst develops from dilatation of a salivary gland duct but is distinguished from a mucus retention cyst by the fact that it does not typically contain pools of mucin. The differential diagnosis of swelling of the lips in children should also include vascular malformations, such as hemangiomas and varices. Usually blue in color, these blanch under digital pressure, which distinguishes them from other pigmented lesions, such as nevi, mucoceles, hematomas and melanomas.

Treatment

Lesion can be excised completely or treated with an unroofing procedure (marsupialization) because excision or dissection is problematic and risks vital structures, such as the labial branch of the mental nerve. Simple incision with subsequent drainage of the cavity is unsuccessful in 100% of the cases. Excisional biopsy was performed, and the wound was closed with 4-0 sutures (gut for deep closure and silk superficially).

On intraoral examination, a solitary, well-defined, dome-shaped swelling was seen on the right buccal mucosa measuring around 3 × 3 cm in size, which was oval in shape, with a smooth surface and a bluish translucent hue. The swelling was soft in consistency, nontender, fluctuant, compressible, nonreducible, and nonpulsatile, with no increase in temperature. Since the lesion was not very large, complete excision of the lesion was done. The lesion was first marked to know the extent of the lesion. After making the extent of the lesion, incision was placed on the periphery on one side the whole of the growth was raised from below including all the nodules to prevent the recurrence (Figs 4 and 5). All the fluid filled nodular remanents were removed. Followed which sutures were placed. The tissue was sent for histopathologic investigation which revealed a mucin-filled cyst-like cavity beneath the mucosal surface (Fig. 6). The patient was kept under observation.

Outcome and Follow-up

Patient was called for regular check-up. On 3 and 6 months follow-up, the lesion showed progressive
healing without any signs of recurrence. Patient is still under observation (Fig. 7).

**DISCUSSION**

A mucocele is a benign mucous retention phenomenon that results from extravasation or retention of mucus in the surrounding tissues. It typically presents as a translucent, bluish nodule on the lateral aspect of the lower lip. Trauma, such as from biting the lip is assumed to cause most mucoceles. Mucoceles typically present as single, recurrent, painless, well-circumscribed, bluish nodules. Most mucoceles range in size from 2 to 10 mm in diameter. On the basis of histopathologic examination, mucoceles can be divided into two categories. The first category includes extravasation mucoceles, the more common type of mucoceles, which arise from ductal damage that causes mucus pooling in the adjacent tissue. The second category includes retention mucoceles, which result from obstruction of the excretory duct, leading to the retention of secretions and subsequent dilatation of the duct. Extravasation mucocele results from a broken salivary gland duct and consequent spillage into the soft tissue around this gland. Retention mucocele appears due to decrease or absence of glandular secretion produced by blockage of salivary gland ducts. The histological difference between extravasation and retention cyst is that the extravasation type has no epithelial lining and is formed by a mucus pool surrounded by granulation tissue and the retention cyst has an epithelial lining. The history and clinical findings lead to the diagnosis of a mucocele.

Conventional treatment for mucocele commonly involves surgical extirpation of the surrounding mucosa and glandular tissue down to the muscle layer. With a simple incision of the mucocele the content would drain out but the lesion would reappear as soon as the wound heals. Small mucoceles can be removed completely with the marginal glandular tissue before suture. In the case of larger mucoceles, marsupialization would avoid damage to vital structures. Cryosurgery and CO₂ lasers can also be used for excision of mucocele. Marsupialization will only result in recurrence, but large lesions are best treated with unroofing procedures (marsupialization). It is done to prevent significant loss of tissue or to decrease the risk for significantly traumatizing the labial branch of mental nerve.

**Learning Points**

- History taking, clinical examination and histopathological assessment are necessary steps to form a proper diagnosis.
- During surgical excision care should be taken to eliminate all the glandular acini to prevent recurrence.
- Care should be taken to avoid injury to adjacent vital structures during excision.

**REFERENCES**

Keratocystic Odontogenic Tumor of the Maxilla Associated with Palatally Impacted Maxillary Canine: A Rare Case Report

Sonal Agarwal, KY Giri, Niranjanaprasad B Indra, Ramakant Dandriyal

ABSTRACT

The most common maxillary location for a keratocystic odontogenic tumor (KCOT) is the canine region where they commonly are mistaken for an inflammatory radicular cyst or dentigerous cyst or a lateral periodontal cyst or even a nasopalatine cyst. This misdiagnosis occurs mainly because of the appearance of KCOT as a unilocular radiolucency in the maxilla, particularly if the KCOT is found coincidentally with a non vital tooth. Additionally, the cyst is frequently infected producing pus that obscures the typical white cheesy material. A misdiagnosis based solely on clinical information can lead to the possibility of the patient being treated with a conservative endodontic therapy or even conservative surgical techniques thereby greatly increasing the chances of progression or recurrence of this aggressive lesion. Here, we report one such case diagnosed and treated aggressively during the primary treatment of the impacted tooth itself.

Keywords: Impacted maxillary canine, Keratocystic odontogenic tumor, Odontogenic keratocyst, Unilocular radiolucency.

INTRODUCTION

Keratocystic odontogenic tumor (KCOT), formerly known as odontogenic keratocyst (OKC) is described as developmental, benign, but locally aggressive lesion characterized by invasive growth into a neighbor structures with high rate of recurrences etiological factors of KCOT occurrence include dental lamina remnants and extension of basal cells of overlying oral epithelium, although DNA mutations are not excluded.

The most common clinical symptoms of tumor presence are localized asymptomatic swelling associated with mobility of the teeth, and spontaneous drainage into the oral cavity, which usually occur in mandibular arch, in association with impacted maxillary canine also.1

An impacted maxillary canine is rarely diagnosed during a routine dental examination. Disturbance in the eruption of permanent maxillary canines can cause problems in the dental arch and adjacent teeth, which require special care and attention.

Clinicians have various definitions of ‘impaction’.2-6 Canine impaction can be defined as an unerupted tooth after its root development is complete; or a tooth still unerupted when the corresponding tooth on the other side of the arch has been erupted for at least 6 months and has a complete root formation; or a condition in which a tooth is embedded in the alveolus and is locked in the bone, adjacent teeth, or other obstacles and cannot properly erupt into the oral cavity. This includes teeth in which eruption is significantly delayed and there is no clinical or radiographic evidence that further eruption is likely to happen.

Maxillary canines are among the last teeth to develop and have the longest period of development. They also have the longest and most devious path of eruption from the formation point lateral of the piriform fossa to the final position in the dental arch. Therefore, there is an increased potential for mechanical disturbances resulting in displacement and impaction.7 Genetic factors are largely responsible for this anomaly. Other causes suggested for canine impactions are usually the results of any one or combination of the following factors: Tooth size-arch length discrepancies, prolonged retention or early loss of the deciduous canine, abnormal position of the bud, dilacerations of the root, ankylosis, cystic or neoplastic formation and the absence of the maxillary lateral incisor. This makes the maxillary canine the second most commonly impacted tooth, after third molars.

Permanent maxillary canine impaction has been reported in about 1 to 2% of the population. The presence of the impacted canine may cause some effects such as migration of the neighboring teeth and loss of arch length, internal resorption, dentigerous cyst formation,
external root resorption of itself as well as the neighboring teeth and combinations of the above sequelae. Potential complications emphasize the need for close observation of the development and eruption of these teeth during the examination of the growing child. Research indicates that women are twice as likely as men to have impacted maxillary canines. The prevalence of impacted maxillary canines is between 0.9 and 2%. It has been found that maxillary impacted canines occur palatally 85% of the time while only 15% of impactions occur labially.7

CASE REPORT

A 40-year-old female was reported to OPD of the Department of Oral and Maxillofacial Surgery, IDS, Bareilly, with a chief complaint of swelling over her right palatal region since 2 to 3 months. The patient gave a history of pus discharge from her palate since 1 month for which she went to some private doctor and took medication. She was asymptomatic for some time but the same problem recurred for which she consulted us for further treatment.

On extraoral examination, there was no relevant findings. On intraoral examination, there was a missing tooth in her upper right quadrant along with palatal swelling. The palatal swelling was extending from 11 to 14 region, roughly oval in shape, measuring 1.5 × 1.5 cm in dimension. On palpation swelling was hard and non tender. Clinically at this stage, palatally impacted canine was suspected as a provisional diagnosis. An occlusal view was advised, in which a well-defined radiolucency was visualized with palatally impacted canine (Fig. 1). On the basis of the above clinical and radiographic examination, a provisional diagnosis of palatally impacted maxillary canine associated with a dentigerous cyst was made. A palatal splint was made and all blood investigations were done before surgical procedure.

Surgical procedure: A crevicular incision was given and palatal flap was raised from first premolar to first premolar crossing the midline (Fig. 2). Full thickness mucoperiosteal flap was raised and cystic lining was removed which was thick and firmly adhered to underlying

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Fig. 1: Occlusal radiograph showing impacted maxillary canine tooth with well-defined radiolucency

Fig. 2: Crevicular incision extending from maxillary first premolar to first premolar

Fig. 3: Reflection of full thickness mucoperiosteal flap showing bony swelling on palatal aspect of 11,12,14 region

Fig. 4: Luxated impacted maxillary canine along with cystic lining
bone, along with impacted canine in toto, followed by closure of surgical site with the help of 3–0 vicryl (Figs 3 to 5). Postoperatively, palatal splint was placed for about 1 week period. The specimen was sent for biopsy. The histopathological report revealed (Figs 6 and 7). Keratocystic odontogenic tumor which is a rare entity in conjunction with impacted maxillary canine.

**DISCUSSION**

The OKC was first described by Philipsen in 1956. In 1967, Toller suggested that KCOT may be best regarded as a benign neoplasm rather than a conventional cyst based on its clinical behavior. The OKC is now designated by the World Health Organization (WHO) as KCOT and is defined as a ‘Benign uni or multicystic intraosseous tumor of odontogenic origin with a characteristic lining of parakeratinized stratified squamous epithelium and a potential for an aggressive infiltrative behavior’.7

Keratocystic odontogenic tumor is commonly seen in the second and third decades. The frequency is higher in males than females. The mandible is involved much more frequently than the maxilla in a 2:1 ratio. The most common site is the posterior portion of the body or ramus of the mandible but the anterior portion of the maxilla, the maxillary third molar area and the maxillary antrum are involved less frequently. The tumor may appear as unilocular or multilocular radiolucency with distinctly corticated, often scalloped border with expansion, especially toward the lingual (medial) side and growth along the length of the mandibular bone with displacement of developing teeth and/or separation or resorption of the roots of erupted teeth and extrusion of erupted teeth. Sometimes a radiolucent lumen or occasionally a cloudy milky appearance of the lumen on the panoramic radiograph are seen. Differential diagnosis of KCOT in the maxillary anterior region includes lateral periodontal cyst, periapical cyst/granuloma, odontogenic cyst, globulomaxillary cyst, dentigerous cyst, denomatoid odontogenic tumor, ameloblastoma, central giant cell granuloma and calcifying odontogenic cyst.

Occasional presence of multiple or bilateral tumor is evident. Treatment of OKCs have ranged from marsupialization, enucleation to en bloc resection.8,9 Carnoy’s solution and cryosurgery are also advocated as it eliminates epithelial remnants and dental lamina in the osseous margin. Carnoy’s solution is a tissue fixative that penetrates bone to a depth of 1.54 mm at the end of 3 minutes of application. Browne evaluated three different treatment methods, which were marsupialization, enucleation and primary closure and enucleation and packing, open and concluded that there was no correlation between treatment method and the rate of recurrence.

Keratocystic odontogenic tumor has an unusually high recurrence rate that ranges from 5 to 62.5%. Studies have shown that the recurrence rate of keratocysts treated with enucleation was as high as 12%.9 Presence of additional remnants of dental lamina, from which a
tumor might develop, presence of satellite cysts and a thin friable epithelium in KCOT all add to the high recurrence rate and the reason why it develops more aggressively than any other jaw tumor. The recurrence rate is almost comparable to that of ameloblastoma.

The histopathology of KCOT shows epithelial layer that lacks rete ridges. In addition, it has a corrugated parakeratinized luminal layer and a prominent basal cell layer. Palisading of the basal cells and a thin friable epithelium are also seen.

**CONCLUSION**

Canine impaction is a relatively frequent clinical presentation in dentistry, with challenges that should be resolved. A good understanding by the clinician of the situation and treatment options can have a significant impact on the treatment outcome. Therefore, clinicians should be competent to perform the proper investigation, provide a correct diagnosis, develop an optimum treatment plan, and render appropriate treatment for each individual patient so each patient realizes the best outcome possible. Any unilocular or multilocular lesions of either jaw irrespective of the internal structure and type of borders should include a differential diagnosis as KCOT as the typical feature of KCOT may not be present.

**REFERENCES**

Laser-assisted Sulcular Debridement

Deepak Singla, RG Shiva Manjunath, Akanksha Singh, Hirak S Bhattacharya, Rika Singh, Arijit Sarkar

ABSTRACT

Background: The use of certain lasers has been proposed as an adjunctive method for nonsurgical periodontal therapy. The objective of this case report was to investigate the effects of diode laser on the microbiological and clinical periodontal parameters following scaling and root planing (SRP).

Materials and methods: A patients with moderate to severe chronic periodontitis, each with probing pocket depth of 5 to 6 mm was selected. Preoperative and 1 week postoperative anaerobic microbiological samples were taken from subgingival areas. Clinical parameters including probing pocket depth, clinical attachment loss and bleeding on probing were recorded at 0, 1 and 3 months.

Results: The treated patient revealed significant improvements in pocket probing depth, clinical attachment level, and bleeding on probing and there was significant reduction in anaerobic bacterial count postoperatively.

Conclusion: Diode laser can be suggested as an adjunctive method for treatment of moderate periodontal pockets nonsurgically.

Keywords: Diode laser, Nonsurgical periodontal therapy, Scaling and root planing.


Source of support: Nil

Conflict of interest: None

INTRODUCTION

Periodontitis is a bacteria—related inflammatory disease which leads to the destruction of tooth-supporting tissues. Nonsurgical treatment of such destructive periodontal diseases is based on the elimination of bacterial deposits adhered to tooth surfaces, primarily by means of root scaling and planing. A thorough removal of these harmful substances is an essential part of the periodontal therapies. The limitations of this method warrant a set of adjunctive methods in order to maximize the therapeutic effects. In order to minimize the bacterial load in the periodontal site several nonsurgical methods were used, such as antibiotic therapy, local drug delivery, host modulation, ultrasonic scaling and root planing (SRP). The invention of lasers and its use in nonsurgical therapy is an emerging field in the treatment of periodontal disease. The use of lasers as an adjunctive method in periodontal pocket therapies has been investigated, and it is now considered as one of the most remarkable technical modalities for nonsurgical periodontal treatment because of excellent tissue ablation and strong bactericidal and detoxification effects. Numerous studies have also shown the success in application of lasers, such as CO2, Diode, Nd:YAG and Er:YAG Laser’s for the treatment of periodontal pockets. Diode laser has been compared to the other lasers. Diversity of studies intended to evaluate its potential in relation to its biocompatibility and to its ability in reducing bacterial counts. Microbiological culture was chosen for this case report because it is the gold standard method for identification and counting of the colonies. As far as the bacterial reduction in periodontal pockets is concerned, the diode laser is expected to have a disinfecting thermal effect on the bacteria that is basically limited to the root surfaces. Therefore, this case report is to emphasize the therapeutic effects of lasers in the treatment of periodontal pockets and to evaluate the use of diode lasers as an adjunct to nonsurgical periodontal therapy.

CASE REPORT

A 45-year-old female patient reported to the department of periodontics with a chief complaint of swelling and bleeding from gums all around since 1 year. Patient gave history of spontaneous bleeding from gingiva while brushing which relieves on its own. Patient uses hard toothbrush in horizontal manner. Nothing relevant medical history recorded and patient was not undergoing any medication. Periodontal examination revealed generalized 5 to 6 mm of pockets were present (Fig. 1). The moderate periodontitis is not subjected to the surgical periodontal therapy and they also do not respond well to conventional SRP. Therefore laser therapy was advised as nonsurgical periodontal therapy to treat periodontal pockets and to eliminate the pathogenic bacteria.
Treatment Protocol

The patient was explained about the treatment protocol and the written consent was obtained from the patient prior to the start of the procedure. The microbiological samples were obtained from the subgingival area to evaluate the decrease in the amount of anaerobic bacteria after the laser application. Then the hard side of the pocket (tooth and root surface) is first debrided with piezoelectric ultrasonic scalers. This is followed by laser application in the subgingival areas for bacterial reduction and coagulation of the soft-tissue (epithelial) side of the pocket. The power was kept at 1 watts as compared to the study done by Kreisler et al in which greater pocket depth reduction and gain in clinical attachment was obtained. The fiber is used in light contact with a sweeping action that covers the entire epithelial lining, from the base of the pocket upward. The fiber tip is cleaned often with a damp gauze to prevent the build-up of debris (Fig. 2). After re-evaluation the vitamin E capsules were applied for better healing and the patient was given postoperative instructions. The patient was recalled at 1 week, 1 and 3 months intervals.

Microbiological Sample Collection

The anaerobic microbiological sampling was done by collecting subgingival plaque at baseline and 1 week recall visit. For subgingival plaque collection, the teeth were isolated with cotton rolls and a plaque sample was obtained by the introduction of two sterile no. 40 paper cones inside the pocket for 30 seconds. The samples were placed in a vial containing 10 ml Robertson cooked meat (RCM) broth medium. The samples were placed into the petri-dishes containing blood agar. After 3 days of incubation at 37°C in an atmosphere containing 5 to 10% carbon dioxide (CO₂), the colonies were counted.

RESULTS

At the 1 month recall visit, a greater reduction in the pocket probing depth, bleeding on probing, clinical attachment loss and the most important the bacterial count was observed (Fig. 3). The results are described in Table 1.

DISCUSSION

Laser treatment is expected to take a role as an alternative or adjunctive to conventional mechanical therapy in periodontics due to various advantages, such as easy handling, short treatment time, homeostasis and decontamination and sterilization effects. For the past decades, adjunctive use of high-intensity lasers has been investigated in the treatment of periodontitis and peri-implantitis. After SRP, the diode laser is used on the soft-tissue side of the periodontal pocket to remove...

Table 1: Mean reduction in clinical and microbiological parameters

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Baseline</th>
<th>1 week</th>
<th>1 month</th>
<th>3 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pocket probing depth</td>
<td>4.52 mm</td>
<td>—</td>
<td>2.2 mm</td>
<td>3.2 mm</td>
</tr>
<tr>
<td>Clinical attachment level</td>
<td>3.4 mm</td>
<td>—</td>
<td>1.0 mm</td>
<td>2.0 mm</td>
</tr>
<tr>
<td>Bleeding on probing</td>
<td>2.8</td>
<td>—</td>
<td>2.3</td>
<td>1.6</td>
</tr>
<tr>
<td>Anaerobic bacterial count</td>
<td>$2 \times 10^8$</td>
<td>$1.2 \times 10^8$</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>
Laser-assisted Sulcular Debridement

JDSOR

the inflamed soft-tissue and reduce the pathogens. The results showed that diode laser irradiation promote additional benefits to the nonsurgical treatment, as regards clinical and microbiological parameters. Diode laser adds beneficial effects to conventional nonsurgical treatment of chronic periodontitis and can be used as an adjunct to treatment of chronic periodontitis with SRP.

CONCLUSION

Diode lasers provide the better clinical results when combined with the conventional therapy and may eliminate the need of periodontal surgeries in the patients having moderate periodontal pockets.

REFERENCES

Odontogenic Myxoma of the Maxilla: A Case Report with Review of Literature

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ABSTRACT

Odontogenic myxomas (OMs) are rare benign mesenchymal tumors of head and neck with a potential for local infiltration and recurrence. They appear to originate from the dental papilla, follicle or periodontal ligament in mandible and less commonly in maxilla. They usually present in second or third decade of life as slowly progressive space occupying lesion in the jaw, giving a mixed radiopaque-radiolucent appearance. The treatment is considered to be wide local excision in view of high recurrence along with curettage. Here, we present a case of odontogenic myxoma of maxilla, in 18 years old adult, with a brief review of literature, clinical, radiological, histopathological characteristics.

Keywords: Mesenchymal tumor, Myxoma, Odontogenic.

Case Report

An 18-year-old male presented with chief complaint of painless swelling in right middle third of the face since one and a half years. His past medical history was of no relevance and general physical status was satisfactory. Extraoral examination revealed swelling in middle third of the face which extends from ala of the nose to the tragus of ear which is localized and nontender (Fig. 1A). On intraoral examination, there is obliteration of buccal vestibule in the region of 12 to 16 (Fig. 1B) with negative for aspiration. Reconstructed panoramic image using Dentascan Software revealed opacification of the right maxillary sinus and the size of the pathology to be 35 × 33.9 mm extending from 12 to 16 region (Fig. 1C). Incisional biopsy of the lesion was performed. On microscopic examination, loosely arranged angular, spindle and comma shaped cells resembling dental papilla in a delicate myxoid stroma were noted (Fig. 1D). Numerous cells demonstrate long, thin, fine anastomosing processes that tend to intertwine the collagenous matrix which was suggestive of odontogenic myxoma (Fig. 1E).

The tumor was surgically excised under general anesthesia. The gross macroscopic examination of the excised specimen showed a white gelatinous appearance. Microscopic examination of the same confirmed the diagnosis of incisional biopsy. Patient recovery was...
uneventful and upon 1 year follow-up showed no evidence of recurrence.

DISCUSSION

Odontogenic myxoma is a tumor considered to be arising from embryonic mesenchymal elements of dental anlage, such as dental papilla and Hertwig’s epithelial root sheath. Evidences supporting the odontogenic origin are: (a) its occurrence is almost exclusive, only to the tooth bearing areas in the jaws, (b) occasional association with an unerupted tooth or a missing tooth, (c) occurrence in younger individuals, (d) histological resemblance to dental papilla, and (e) occasional presence of odontogenic epithelial island.

The OM cells articulate extracellular membrane molecules, like fibronectin, type 1 collagen and tenasin resembling human immature dental papilla stem cells. Nestin, a marker for progenitor cells, was affirmative in the stromal neoplastic cells of the OM. So, Martinez-Mata G et al suggested that the possible origin of tumor cells are from the dental papilla cells, fibroblasts or myofibroblasts. Using the notch signaling, Nakano et al concluded that the differentiation level of the tumor tissue is similar to that of cap stage.

Zhang et al, classified radiographic appearances of OM into six types—type I: Unilocular well-defined radiolucency, type II (multilocular): two or more compartments with multiple interlaced osseous trabeculae described as honeycomb, soap bubble or tennis racquet radiolucency, type III: lesion located in alveolar bone, type IV: lesion involving the maxillary sinus, type V (mouth eaten appearance): larger radiolucent area with irregular borders and type VI: combination of bone destruction and bone formation giving sun ray appearance.
On gross tissue examination, myxoma appears as a mass of characteristically mucoid, white gelatinous slimy material. Microscopically, odontogenic myxomas demonstrate spectrum of fibrous connective tissue stroma from myxoid to densely hyalinized and from relatively acellular to cellular nature. The tumor shows loosely arranged stellate or spindle shaped cells resembling dental papillary cells in a delicate myxoid stroma. It was sometimes called odontogenic fibromyxoma, because cells were active with granular cytoplasm, dense diffuse collection of fibrils and fibroblasts.

Histopathological differential diagnosis of OM should include a developing dental papilla, dental follicle and non-odontogenic tumors with myxomatous degeneration, such as myxoid neurofibroma, myxoid osteosarcoma, mesenchymal chondrosarcoma, myxoid lipoma, myxoid liposarcoma, myxoid fibrosarcoma, and chondromyxoid fibrosarcoma. Histochemical studies of the mucoid intercellular substance have revealed the presence of large quantities of hyaluronic acid.

Ultrastructural and immunohistochemical studies have shown that the tumor cells positively react with vimentin and muscle-specific actin. Several studies on S-100 and glial fibrillary acidic protein positivity have given conflicting reports. The treatment for the OM is quite variable. The current literature recommended therapy depends on the size of the lesion and on its nature and behavior and can vary from simple curettage and peripheral ostectomy up to segmental resection.

REFERENCES

Management of Radicular Cyst

Anuj Agarwal, Anurag Singhal, Vineet Vinayak, Anuraag Gurtu, Sumit Mohan Sharma

ABSTRACT

Radicular cysts are the most common cystic lesions which affect the jaw with incidence of 52 to 68% of the entire jaw cysts. A radicular cyst arises from epithelial remnants stimulated to proliferate by an inflammatory process originating from pulpal necrosis of a nonvital tooth. They are generally asymptomatic and are diagnosed during routine radiologic investigations. The treatment of radicular cysts includes conventional nonsurgical root canal therapy when lesion is localized or surgical treatment, like enucleation, marsupialization or decompression when lesion is large. This case report discusses the management of radicular cysts associated with maxillary anteriors (maxillary right central and lateral incisors) after performing apicoectomy with mineral trioxide aggregate (MTA) as a retrograde filling material.

Keywords: Apicoectomy, Enucleation, Mineral trioxide aggregate, Periapical lesion, Radicular cyst.

INTRODUCTION

A radicular cyst is generally defined as a cyst arising from epithelial residues (cell rests of Malassez) in the periodontal ligament as a consequence of inflammation, usually following the death of the dental pulp. Radicular cysts are the most common odontogenic cystic lesions of inflammatory origin affecting the jaws. They are most commonly found at the apices of the involved teeth; however, they may also be found on the lateral aspects of the roots in relation to lateral accessory root canals.

Many radicular cysts are symptomless and are discovered when periapical radiographs are taken of teeth with nonvital pulps. Over the years, the cyst may regress, remain static or grow in size. The treatment of the cysts can be either nonsurgical management or surgical management being either marsupialization or enucleation. The treatment of choice is dependent on the size and localization of the lesion, the bone integrity of the cystic wall and its proximity to vital structures. Nevertheless, no matter what choice it might be, the treatment option should be kept as conservative as possible.

Apical surgery for radicular cysts generally involves apical root resection and sealing with endodontic material. Currently, the preferred root-end filling material is mineral trioxide aggregate (MTA) because it has some biological properties, such as induction of calcification that enables biological sealing. Mineral trioxide aggregate, when used as a root-end filling material, showed evidence of healing of the surrounding tissues. Studies have shown that osteoblasts have favorable response to MTA as compared to intermediate restorative material (IRM) and amalgam. With longer duration, new cementum was found on the surface of the material. Mineral trioxide aggregate is a widely accepted retrograde filling material which is biocompatible, has antibacterial action and reduces microleakage. Mineral trioxide aggregate plugs of 4 mm thickness have been shown to be the most efficient with respect to root canal sealing ability and resistance to displacement.

The present case report discusses management of a large maxillary radicular cyst by apicoectomy using Pro-Root MTA as a root end filling material.

CASE REPORT

A 24-year-old male patient reported to the department of conservative dentistry and endodontics with a chief complaint of swelling in the upper front region of jaw since last 1 year. Patient gave history of trauma in upper anterior teeth, 3 to 4 years back.

Extraorally, no abnormality was detected. On intraoral examination, a diffuse swelling was observed extending from right maxillary central incisor to right maxillary first premolar measuring 2 × 5 cm (Fig. 1). There was no mobility of the involved teeth. Tooth discoloration evident with right maxillary central incisor. Purulent discharge was present. Electrical pulp testing (using C pulse pulp tester by Coxo Medical Instrument Co. Ltd.) revealed...
nonvital right maxillary and lateral incisor. Intraoral periapical radiograph showed a well-defined unilocular radiolucency in the periapex of right maxillary central and lateral incisors, extending from the mesial aspect of right maxillary central incisor till the mesial aspect of right maxillary canine (Fig. 2). Hematological examination revealed values within normal limits.

From the history, clinical examination and investigations, a provisional diagnosis of radicular cyst was made in respect to right maxillary central and lateral incisors. Treatment plan was formulated, explained and the informed consent was obtained from the patient. Root canal opening was done under rubber dam application. After determination of working length and biomechanical preparation, calcium hydroxide intracanal medicament was placed for 1 week. In next appointment, obturation was completed. Patient was prepared for surgery in next visit, which included surgical enucleation of cyst, apicoectomy and retrograde filling of involved tooth.

After administration of local anesthesia (infraorbital nerve block, nasopalatine nerve block and local infiltration using 2% lignocaine hydrochloride and adrenaline solution), crevicular incision was made in labial region extending from left maxillary central incisor till right maxillary first premolar with vertical releasing incisions. A full thickness mucoperiosteal flap was reflected extending from mesial of left maxillary central incisor to mesial of right maxillary first premolar and a plane of cleavage was established between cystic epithelial lining and the surrounding bone (Fig. 3). Bony window was created and the lesion was exposed (Fig. 4). Complete curettage, along with granulation tissue removal and enucleation of cystic lesion was done and it was sent for histopathological evaluation (Fig. 5).

Root end of maxillary right central and lateral incisors was resected and retrograde filling was done with ProRoot MTA, (Fig. 6) and primary flap closure was done with 3-0 silk sutures through simple interrupted suturing technique. Coe-pak was placed and proper postoperative instructions were given. Patient was kept on antibiotics and analgesics. Patient was recalled after 1 week for suture removal. Currently, the patient is asymptomatic.
and he is under follow-up since 1 year. Follow-up radiograph shows appreciable uneventful healing (Fig. 7).

The excised tissue was sent for histopathological examination which showed a lining epithelium, a cystic cavity and a fibrous capsule. The lining epithelium was stratified squamous and nonkeratinized showing characteristic arcading pattern. The connective tissue was fibrous with dense infiltrate of inflammatory cells. The inflammatory cells were predominantly lymphocytes and plasma cells suggestive of chronic nature of the lesion. Upon clinic-pathologic correlation, the diagnosis of radicular cyst was confirmed (Fig. 8).

DISCUSSION

The term, ‘cyst’ is derived from the Greek word, ‘Kystis’, meaning, ‘sac or bladder’.5 Cyst is defined as a pathological cavity that is usually lined by epithelium and which has a centrifugal, expansive mode of growth.6

Radicular cysts are the most common cystic lesions which affect the jaw. They are most common of all the jaw cysts and comprise about 52 to 68% of all the cysts which affect the human jaw.7,8 They arise from epithelial remnants which are stimulated to proliferate, by an inflammatory process which originates from pulpal necrosis of a nonvital tooth.

Simon discovered two distinct types of radicular cysts, namely those containing cavities completely enclosed in epithelial lining or true cysts, and those containing epithelium-lined cavities that are open to the root canals.9

Most radicular cysts develop slowly and do not become very large cavities. Patients do not experience pain unless inflammatory exacerbation is present. Large cysts may lead to mobility and not respond to electrical pulp test in affected tooth.10

They are most commonly found at the apices of the involved teeth. However, they may also be found on the lateral aspects of the roots in relation to lateral accessory root canals.7 They are symptomless and are diagnosed during routine radiologic investigations. The treatment for radicular cysts includes conventional nonsurgical root canal therapy when lesion is localized or surgical
Radicular cysts generally originate after trauma or dental caries. Dental caries cause inflammation of the pulp cavity, leading to pulp necrosis. The infection then spreads to the tooth apex of the root, causing periapical periodontitis, which leads to either an acute abscess or a chronic granuloma. Persistent chronic infection can lead to formation of a periapical cyst. In the current case, patient had given a history of trauma previously; it could be the probable etiology.

Cortical expansion and root resorption of the affected tooth and displacement of the adjacent teeth are common features of radicular cysts. In the current case, there was cortical perforation and adjacent teeth in relation to the cyst were nonvital, which is not common. It has been stated that as the cyst enlarges, adjacent teeth can become nonvital. The use of root canal dressings between sessions in root canal treatment of teeth with chronic periapical lesions is important, for reducing bacteria which are unreachable by instruments or irrigation solutions, such as dentinal tubules and ramifications. Takahashi et al, after analyzing the pH and the concentration of calcium ions in the periapical area, concluded that at least 2 weeks were necessary for calcium hydroxide bactericidal activity. In the current case, calcium hydroxide intracanal medicament was used.

When the canal is wide and walls are parallel, the tapered shape of GP will not fit adequately. In such cases, it is necessary to roll three or more GP cones together on glass slab, in order to make a thick GP cone of even diameter. In the current case, tooth left maxillary central incisor presented with wide canals with open apex. It was successfully managed by roll cone technique obturation.

Due to the large size of the lesion, conservative surgical approach was planned. Conservative approach involves the removal of the infected tissues as compared to procedures like En bloc resection, which involves removal of the normal structure along with diseased tissue. The surgical approach to cystic lesions of the jaws is either marsupialization or enucleation. The treatment of choice is dependent on the size and localization of the lesion, the bone integrity of the cystic wall and its proximity to vital structures. Mineral trioxide aggregate is widely used as a root end filling material. Mineral trioxide aggregate has been favored due to its higher biocompatibility and sealing ability over the currently available root-end filling materials. In the current case, the lesion was enucleated along with curettage, followed by apicectomy and placement of MTA as root end filling material.

Post surgical period was uneventful. The histopathological features of the submitted lesion were consistent with the clinical diagnosis of infected radicular cyst. The cystic cavity was lined by non-keratinized, stratified squamous epithelium with mixed inflammatory infiltration being present. The case was successfully managed with no postoperative complaints after 1 year follow-up.

**CONCLUSION**

The current concept in management of periapical cysts is by using nonsurgical means. Untreated cysts may expand causing local tissue destruction and deformities. However, depending on size and extent of lesion, surgical management might be necessary, for achieving success. Current case was managed successfully by performing endodontic therapy with thorough irrigation, cleaning and shaping and obturation of the canal space, followed by apicectomy and retrograde filling with ProRoot MTA.

**REFERENCES**


