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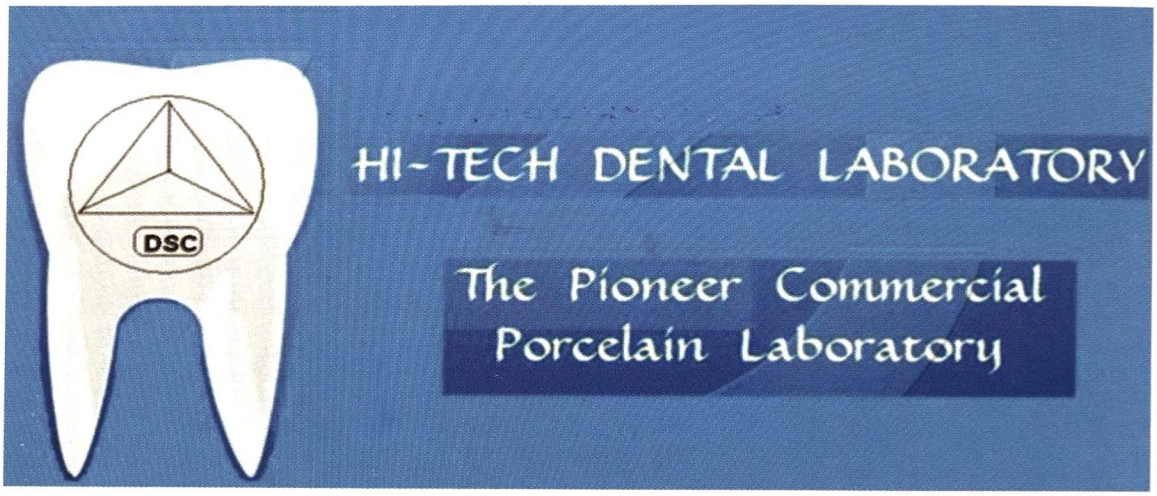

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Sri Lanka Dental Journal

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EDITORIAL

Role of the Dental Practioner in Prevention

Countries with developing economies and health systems have the problem of not being able to provide optimal dental treatment to everybody due to the high cost it entails. This problem is compounded by the fact that these countries lack a well organized dental diseases preventive programme which causes the burden of treatment to rise. This together with escalating cost of treatment makes it prohibitively difficult for the state sector to provide optimal dental treatment. The apparent advancement that is seen as a palpable reality in the developed world does not seem to touch the lives of poor people in the developing countries. But prevention of dental diseases is easily said than done. The crux of the matter is that the dental profession seems to be predicated to a tradition of cure rather than prevention. The malady perhaps could be traced back to the curriculum in the dental schools. Everybody knows the immense benefits of prevention, to the health and wellbeing of the individual, to the purse of the individual, to the coffers of the health system, to the disease burden of the country and so on and so forth but little or nothing is done to achieve what is achievable.

The dental surgeon at the time he or she takes up duties as a practitioner whether in the state sector or in the private sector finds himself in an environment not very much conducive or geared for prevention of dental diseases. To begin with the dentist has followed a course that does not give due importance and weightage to preventive dentistry. Hence he or she may not be very

much motivated to take the initiative and start a preventive programme which may not find official or even professional support which is essential if it is to succeed. In the state sector the dentist may not be provided with the basic facilities and material to engage in an individual preventive programme leave alone a community based one. In the private sector he may not have the time for preventive procedures and also the income factor may discourage him from going into preventive dentistry in a meaningful way.

Preventive dentistry, if not more, is of equal importance to curative dentistry. The adaptation of this axiom must start in the dental school. The curriculum in the first instance must reflect the importance of prevention. Unless it is given a place of primary importance and not one of secondary importance this attitude will prevail not only in the profession but also the health system. This sad state of affairs is to be found not only in developing countries but also in the developed. They can afford it but we cannot. When prevention fails the disease burden becomes unbearable and optimal treatment cannot be made available to the less affluent in the state sector. For instance molar endodontic treatment could be quite feasible if the numbers are manageable. Numbers could be made manageable only by a successful inclusive preventive campaign. Changes in the dental curriculum may take time to materialize given the present context of things. Yet the profession and the Health Ministry together could address the matter and device a system to solve this problem. The other very important aspect of the problem is that the dental surgeon in the state sector will be frustrated if he is not able to practice the advanced treatment procedures, he or she has so diligently learnt spending time and energy and at great cost to the state too, in the government dental clinics due to prohibitive cost and numbers.

What may perhaps be feasible is to provide the dental surgeon practicing in the government dental clinics with what is required to engage in individual preventive oral health programme. Space, time and material for this have to be made available. Research has shown that individual preventive measures are effective in preventing most oral diseases (World Health Assembly -2003) Dental caries could be reduced by a substantial degree if practiced on children. Fluoride gels, dental sealants, tooth pastes, etc could be used for this purpose. Time may be a constrain for a busy dental surgeon to engage in preventive work when there are so many patients awaiting treatment. Yet for the benefit of everybody this has to be done if the dental profession is to face up to the challenges of modern dentistry.

Dental practitioners in the private sector too could engage in preventive procedures and make it an income generating practice. They could advice parents to bring all their children to the clinic for preventive treatment like application of fluoride gel and dental sealants. They could counsel on tobacco cessation and also alcohol prevention and advice on appropriate diet, nutrition and sugar consumption.

Dental science and technology is advancing very rapidly. The recent advances in cell biology, tissue engineering, gene therapy, nano technology, stem cell technology etc. are causing a revolution in medicine and its direct and indirect effects are spreading into the dental profession as well. For instance it may soon be possible to replace a lost tooth with a laboratory grown tooth using stem cell technology. If the developing countries like Sri Lanka are to benefit from this advancement their preventive dentistry campaign must succeed so that the disease burden is reduced and advanced treatment procedures are made affordable in the government sector. Dental school must take the initiative in this regard so that its products are not frustrated in work after a strenuous training programme and a grueling system of evaluation and their talents are made use of in the service to the people.

Professor N.A. de S. Amaratunga

Clinical update

Sri Lanka Dental Journal 2013; 43(02) 72-80

Computer-controlled local anesthetic delivery (CCLAD) and advanced injection techniques in dental armamentarium

N.S. Soysa

Abstract

With the introduction of cocaine into the field dentistry and subsequent development of newer and safer amide agents like lidocaine (lignocaine), local anesthetics became the backbone of pain control in dentistry. Lidocaine is considered the 'gold standard' due to its superior actions including faster onset, adequate duration and greater reliability and longer duration of pulpal anesthesia when combined with a vasoconstrictor. Before injecting the local anesthetics, application of a small amount of topical anesthetic agent has become an integral part of the delivery of atraumatic injections. To improve the patient comfort further computer-controlled local anesthetic delivery (C-CLAD) devices and systems for intraosseous (IO) injections have been added to the dental anesthesia armamentarium. C-CLD controls the rate of flow of the anesthetic solution to ensure an atraumatic injection irrespective of the density of the tissue. At present several C-CLAD systems are available including Wand, Quicksleeper, Comfort Control Syringe and Anaeject. Two new techniques, AMSA and P-ASA provide dental anesthesia without associated extra oral soft tissue anesthesia. Anesthesia of a single tooth can be obtained using either C-CLAD and intraligamentary or IO injections. Though IO anesthesia is particularly used as a supplementary injection for effective pain control of teeth diagnosed with irreversible pulpitis, in conjunction with specialized equipment like Stabident, X-tip and intraflow, it has become more popular as a primary technique.

Key words: lidocaine, local anesthetics pulpal anesthesia, vasoconstrictor, computer-controlled local anesthetic delivery, intraosseous injections.

Introduction

Local anesthetics form the backbone of pain control in dentistry[1]. The introduction of more and more safe and effective local anesthetic agents has been an important advancement in dental therapeutics. Local anesthetics exert their clinical response by preventing the pain impulse reaching the patient's central nervous system. Local anesthetics reversibly block the nerve conduction by binding to the voltage-gated Na^+ channels and thereby decrease the entry of Na^+ ions into the peripheral nerve[2]. Local anesthetics usually do not affect the resting membrane potential and show high affinity for activated-open and inactivated-closed Na^+ channels. The nerve conduction blockade is more in nerves showing high frequency of depolarization such as spontaneous pain.

A number of properties are desirable for local anesthetic agents and techniques. Completely reversible effect with short and rapid onset of action, adequate duration, efficacy and safety are vital requirements. Other ideal properties include low or no systemic toxicity at an effective concentration, chemically stable with a long shelf life, non-allergenic, non-irritating when administering and a painless anesthetic delivery and a technique that is easy to learn[3]. Neverthe-

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less, an ideal local anesthetic which would induce regional analgesia by selectively inhibiting pain pathways without interrupting transmission of other sensory modalities (temperature, touch, deep pressure and motor functions) has not yet been discovered.

The local anesthetic agents which were more popular in 19th and early 20th century included amino esters like cocaine and procaine. Because of the long onset, unreliability in exerting effect and documented and reproducible allergy to injected procaine, search began for equally effective and safer drugs. The Swedish chemist Nils Löfgrenn in 1943 synthesized a new class of local anesthetic under the trade name *Xylocaine* (Lidocaine/lignocaine) which was marketed in 1948. Lidocaine swiftly replaced the procaine which was the 'gold standard' at that time because of its superior actions including faster onset (3-5 min), adequate duration and greater reliability and longer duration of pulpal anesthesia when combined with a vasoconstrictor like epinephrine (adrenaline). Following lidocaine other amides came to the market such as mepivacaine (1956), prilocaine (1960), bupivacaine (1963) and articaine (1969).

Articaine is the most popular anesthetic agent used in Europe and Canada, whereas lidocaine is popular in USA, India and Sri Lanka. Articaine has the shortest metabolic half-life (27- 42 min) of the anesthetics available in dentistry as it is rapidly metabolized by hydrolysis once absorbed from the injection site into the systemic circulation. Onset, duration and anesthetic efficiency of mandibular block and maxillary infiltration anesthesia of 4% articaine with 1:200,000 epinephrine is comparable to that of 2% lidocaine with 1:100,000 epinephrine though articaine is more effective than lidocaine in providing anesthetic success in first molar region[4]. In addition articaine has superior diffusion properties (due to thiophene ring) enabling pulpal anesthesia following maxillary infiltration in buccal vestibule which provides adequate palatal anesthesia for extractions, and mandibular buccal infiltration provides anesthesia for extractions of anterior and premolar teeth. Though articaine does not confer greater allergenicity than other amide anesthetics and reports of toxicity in dental anesthesia is extremely rare, articaine and prilocaine are known to be associated with inferior alveolar and lingual nerve paresthesia following inferior alveolar nerve block (IANB).

For the local anesthetics to provide an adequate duration of analgesia they must be injected which is the aspect of dentistry that most patients fear. When selecting the dentist, the ability of a dentist to administer a local anesthetic injection painlessly is considered the most important factor by patients[5]. Therefore application of a small amount of topical anesthesia before the injection of the local anesthetic agents has become an integral part of the delivery of atraumatic injections.

Topically applied local anesthetics

Topical application of local anesthetic agent makes the subsequent penetration of the mucous membrane by the needle painless. When applied to an area after drying with a cotton swab with a small amount for 1 to 2 min provides anesthesia to a depth of 2 to 3 mms. As topically applied agent requires diffusion of the anesthetic through mucous membranes to reach the nerve membrane, high concentrations are required compared to the injectable form. Topical local anesthetics are usually compounded agents containing several agents including lidocaine, benzocaine, tetracaine and prilocaine. For example the commercially available flavoured agents such as Tricaine Blue contains 10% lidocaine, 10% prilocaine and 4% tetracaine while Tridocaine contains 20% benzocaine, 6% lidocaine and 4% tetracaine. Though cocaine is a better topical agent, topically applied cocaine is not used in dentistry. A liquid form of a mixture of 2.5% lidocaine and 2.5% prilocaine (Oraqix) is available for periodontal procedures such as root planning and curettage. Oraquix solidifies

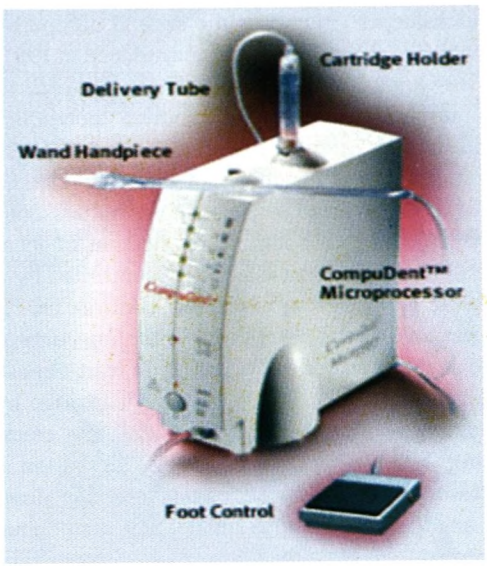
at body temperature into an elastic gel, enabling it to remain in place while the anesthetic takes effect. Oraquix has a duration of approximately 20 minutes and if the anesthesia starts to wear off, it can be reapplied if needed.

Computer-controlled local anesthetic delivery (CCLAD) systems

The rationale behind the use of computer-controlled devices is in part, that computers can do what our hands cannot. That is the computer technology is used to control the rate of flow of the anesthetic solution despite the density of the tissue, so that injection remains consistent from one injection to the next. Injection into the dense or tight tissues like palate is painful due to the lack of tissue space to expand when anesthesia enters. This ultimately causes injection pressure resulting in more pain. On the other hand the computer releases the anesthetic at the same slow rate allowing the tissues to expand gently. The effectiveness of using a CCLAD in reducing pain during injection of local anesthesia was first performed in 1997 using the Wand (Milestone Scientific) system[6]. Today several CCLAD systems are available including Wand, Quicksleeper, Comfort Control Syringe and Anaeject.

Wand™

Wand (Fig. 1) has three components; a table-top microprocessor unit, a foot pedal and a small light weight handpiece that resembles a pen. The foot pedal and the local anesthetic cartridge are attached to the microprocessor. The microprocessor recognizes signals from the foot pedal and allows the advancing of the plunger into the anesthetic cartridge so that local anesthetic flows into the disposable delivery tubing system which connects to the hand piece and needle (therefore a luer lock needle is required).The Wand has two possible rates (slow speed and fast speed) of local anesthetic delivery both controlled from the foot pedal. The slow speed allows for a cartridge of 1.8 ml of solution to be dispensed in four minutes while fast speed will dispense in one minute. Ideally the injections should begin with the slow speed to make the injection as painless as possible. When the operator decides that the tissues are properly anaesthetized, the pedal can be pressed again to change to the fast speed of injection. It is also advisable to use the



slow speed for periodontal ligament injections (PDL) and palatal injections. Aspiration prior to release of local anesthetic solution can be controlled either from the foot pedal or from the microprocessor.

The Wand system enables the operator to handle the needle with fingertip accuracy. The two speed systems allow the operator to select the initial slow speed for a less painful injection while the operator has the ability to change speeds anytime during the injection. Since the cartridge is attached to the microprocessor, the assistant can add another cartridge to the base unit while the needle remains in the patient's mouth. In addition to the above mentioned advantages Wand has some disadvantages as well. The wand system takes five seconds for the aspiration cycle. Because the local anesthetic has to flow from the microprocessor to the needle via

the tubing system there will be loss of 0.3-0.4 ml of local anesthetic making it unable to use the full amount of 1.8 ml. The Wand is not compatible with standard needles and requires a luer lock needle and ongoing maintenance as well.

The Quicksleeper™

Quicksleeper (Fig. 2) is the second computer-controlled device which was introduced in 1991. With Quicksleeper it is possible to perform all intraoral local anesthetic injection techniques with four programmed injection speeds. A built-in motor in the handpiece of the Quicksleeper allows the syringe to perform an intraosseous (IO) injection in addition to injection of local anesthetic. The Quicksleeper is controlled by a double foot pedal in which one controls the IO injection and the other initiates the injection of the local anesthetic. The operator can choose volumes of 1/4, 1/2, 3/4 or a full cartridge by pressing the appropriate button on the countertop base of the machine. Once the button is pressed the Quicksleeper begins injecting slowly and pick up speed gradually. Standard dental needles can be used with the Quicksleeper. The ability to use as an IO injection device and easy handling of the handpiece are some of the advantages of this device. Quicksleeper is the most expensive device compared to the others. Relatively high weight (240 g) of the hand piece and the inability of the operator to control the speed once it increases, are some of the disadvantage of the Quicksleeper.

Comfort Control Syringe (CCS)™

Comfort control Syringe (Fig. 3) is different from the other two discussed above as it has no foot pedal. It is programmed so that five techniques (block, infiltration, palatal, PDL and IO) with their specific corresponding speeds (5 speeds) can be selected depend on the area/tooth to be anesthetized. The CCS has the cartridge just behind the needle just as in a traditional syringe and the injection controls are finger tip accessible on the syringe. The first button is the start/stop button followed by buttons for aspiration function and double rate function. Once the start button is pressed it starts injecting the solution at a slower speed for 10 seconds despite the injection technique selected and automatically changes to the pre-selected technique. The digital readouts on the base unit provide the operator details such as rate of injection, time taken during the injection and the total volume injected.

Figure 2. Quicksleeper with the handpiece

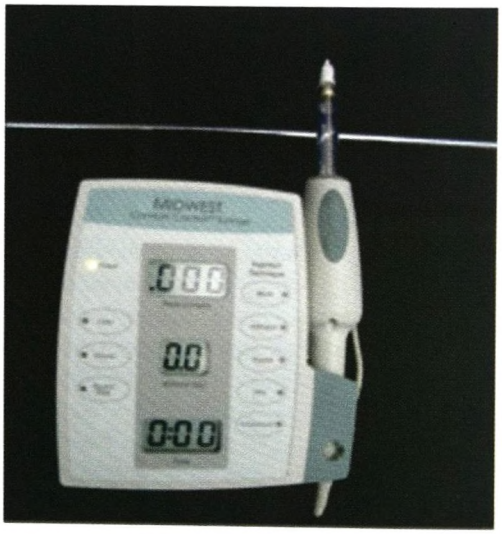


Figure 3. Comfort Control Syringe

CCS is the least expensive and is compatible with the standard dental needles. CCS requires some practice in maneuvering the buttons present in the handpiece and the electronics in the syringe exert some vibration which is not present in the Wand while the Quicksleeper might give a minimal vibration.

Figure 4. Anaeject

Anaeject™

Like CCS, Anaeject (Fig. 4) also does not require a foot pedal to control the injection of solution. Anaeject has two modes with three speeds; low, medium and high. The auto-mode of the device regulates the speed of injection by starting slowly and accelerating the speed of injection to minimize the pain.

New Injection techniques

Dental procedures in the maxilla require multiple injections and may inadvertently anesthetize facial structures and also affect the smile line. The introduction of Wand (CCLAD) has renewed the interest in palatal approach to anesthetize anterior and middle superior alveolar nerves. Therefore the two new techniques AMSA and P-ASA provide anesthesia of the teeth without associated extra oral soft tissue anesthesia. It is important that theses injections are given very slowly with constant visual monitoring to avoid excessive tissue blanching. In the event of blanching, a momentary pause will allow return of normal blood supply so that injection could be continued. Risk of palatal tissue ulceration should be kept in mind when administering these blocks.

AMSA (Anterior middle superior alveolar nerve block)

This block technique for maxillary arch provides pulpal anesthesia of the central incisors up to the 2nd premolar as well as the buccal and palatal tissues on the same side (Fig.5) with a single-site injection of 0.6 to 0.9 ml without collateral anesthesia of the face and muscles of facial expression[7]. The expected anesthesia duration is 45 min to 1 hour. Preservation of normal facial sensation and movement are advantages, especially when performing mid-procedure smile

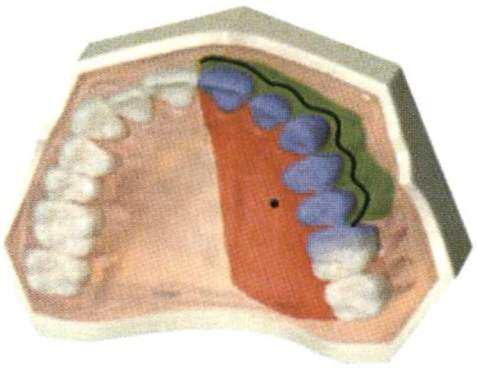


Figure 5. Area anesthetized by AMSA.

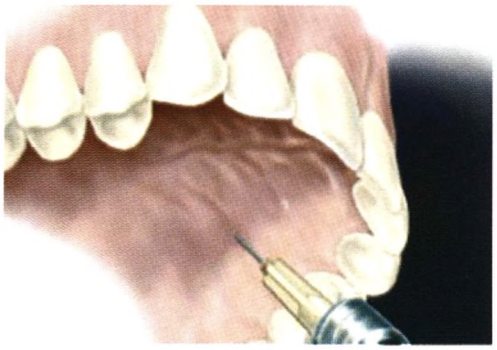


Figure 6. The point of injection of AMSA.

line assessment in maxillary anterior cosmetic procedures. AMSA nerve block injection site is located palatally at a point that bisects the premolars and is approximately halfway between the mid palatine raphe and the crest of the free gingival margin (Fig.6). The injection site is the confluence area of the anterior superior alveolar nerve (ASA) and the middle superior alveolar (MSA) nerve or plexus when the MSA is absent.

P-ASA (Palatal approach-anterior superior alveolar nerve block)

This block provides anesthesia of six maxillary anterior teeth, anterior 1/3 of palate, labial gingiva and mucoperiosteum (Fig.7) from a single-site injection of 0.9-1.4 ml[8]. Similar to AMSA there is no extra oral anesthesia of lips, face or muscles of expression or distortion of smile

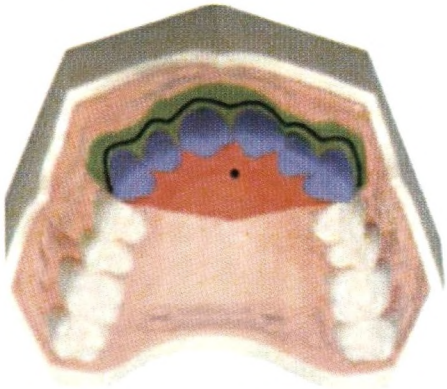


Figure 7. Area anesthetized by P-ASA.

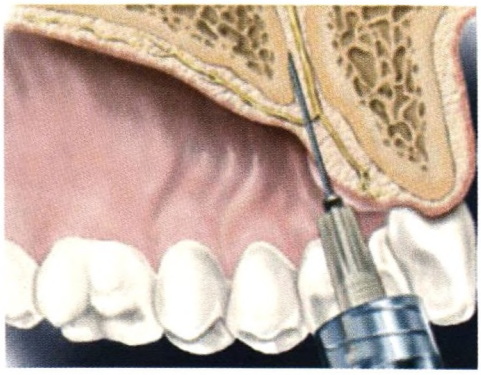


Figure 8. P-ASA injection gains access into the nasopalatine canal

line. The block provides anesthetic duration of 60 min. The main aim is to gain access into the nasopalatine canal (Fig.8) and maintains contact with the inner bony wall with a final target depth of approximately 0.6 to 1.0 cm or approximately the length of a 30-gauge extra short needle. Exceeding the recommended penetration depth may inadvertently perfortate the floor of the nose. The total time taken from the penetration to inject the 0.9-1.4 ml may be 2 to 4 min.

Periodontal ligament injection (PDL)

Periodontal ligament injection (PDL) or intraligamentary injection (ILI) can induce local anesthesia in either maxillary or mandibular teeth. The PDL injection (Fig. 9) provides pulpal anesthesia to the tooth, with only localized soft tissue anesthesia developing. When administered in the mandible there is no associated extraoral or lingual anesthesia as expected with IANB. Usually PDL injection is considered as a second

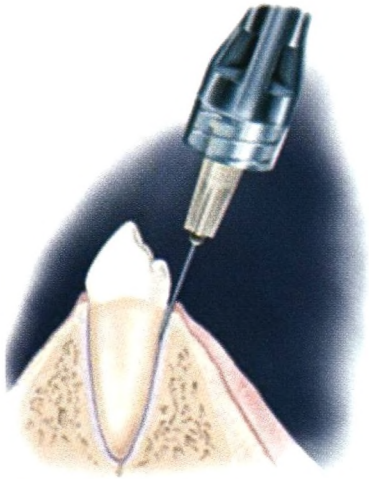


Figure 9. Image showing the intraligamentary injection.

line injection in the event of a failure of a conventional injection like IANB, especially with irreversible pulpitis. Nevertheless it can be used as a primary injection, useful when anesthesia of a single tooth in mandible is desired. The name of the technique is a misnomer, though solution

is deposited into the coronal segment of PDL it reaches the pulpal nerve by entering the cancellous bone via the fenestrations in the dental socket and not forced down the PDL into the tooth apex (Fig. 10).

The technique requires the needle insertion at 30^0 to the long axis of the tooth at the mesiobuccal (or distal) aspect of the root and force the needle until it is wedged between the tooth and the crestal bone and the bevel should face the root to allow easier advancement. Another recommendation is to insert the needle with the bevel facing the root and then rotate the needle so that it faces the bony socket when the solution is released. Then 0.2 ml (per root) of solution is injected under back-pressure. Rapid onset is an attractive feature of PDL injection and the success rates ranged from 60% for endodontic treatments and 100% for periodontal therapies and extractions. The disadvantages of PDL injection includes possible introduction of bacteremia, damage of the PDL, tenderness at the injection site and possible entry of local anesthetic and the vasoconstrictor into the systemic circulation via socket wall. Due to the absence of unnecessary soft tissue anesthesia associated with PDL this is a good adjunct to IANB in mandibular teeth anesthesia, especially useful when a single tooth anesthesia is required.

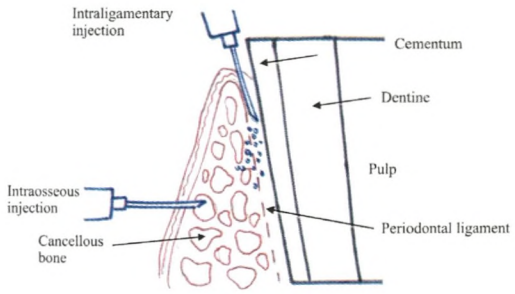


Figure 10. PDL and IO injections deliver local anesthesia from different sites.

Intraosseous (IO) injection

Factors including greater density of the buccal plate and limited access to the inferior alveolar nerve, result in lower success rates of IANB which might further aggravate with the presence of pulpitis. Therefore routine local anesthetic techniques might not prevent nerve transmission of pain and require more advanced techniques like IO injection. Though IO injection is used as a supplementary method to achieve pulpal anesthesia when conventional infiltration and regional block methods are unsatisfactory, similar to PDL injection IO injection is also used as a primary method to anesthetize single tooth or several adjacent teeth. The technique first requires the infiltration of point of perforation with 0.2 ml of local anesthetic to achieve gingival anesthesia. The point of perforation lies in attached gingiva and determined by the two imaginary lines running at right angles; the horizontal line running along the buccal gingival margin and the vertical line running by bisecting the distal inter-dental papilla of the tooth to be anesthetized. The point of perforation is about 2 mm apical to the intersection of these lines. So that the desired penetration zone lies in the cancellous bone apical to the alveolar crest adjacent to the middle third of the root (Fig. 11). The perforation can be performed with the perforator of the specialized equipment with a light pecking motion as the perforator goes through the cortical bone. Then the operator feels a characteristic 'give' feeling when the perforator enters the cancellous bone[9]. Once the perforator is removed, local anesthesia (0.45 ml to 0.9 ml) is injected by inserting a 27-gauge needle through the perforation.

The onset of anesthesia after IO injection is almost immediate with a pulpal anesthesia of 1 hour with a vasoconstrictor and 15 to 30 min without a vasoconstrictor. This technique should use with caution when roots of teeth are so close preventing clear access to inter-dental cancellous bone and contraindicated in patients having gross periodontal disease or acute periapical

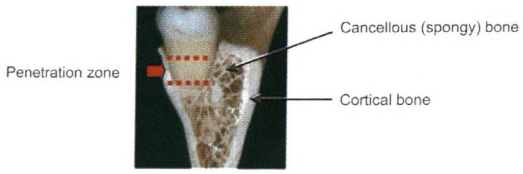


Figure 11. The desired penetration zone is the cancellous bone apical to the alveolar crest adjacent to the middle third of the root.

infection. It is advisable not to use IO injection in children with mixed dentition. Though IO injection technique is considered a supplementary route of local anesthesia by many dentists, with the advent of specialized equipment like Stabident, X-tip and intraflow, it has become more popular as a primary technique.

Stabident™

Stabident (Fig. 12) uses a two-step technique. The perforator needle is first used to penetrate the bone followed by injection of the local anesthetic solution. Stabident is relatively inexpensive because the usual equipment in the dental clinic like contra angle slow speed hand piece with standard dental anesthetic syringe can be used. Because of the two-step technique, If not the perforation is made in a visible and accessible site in the attached gingival it is difficult to relocate the perforation site. This problem is

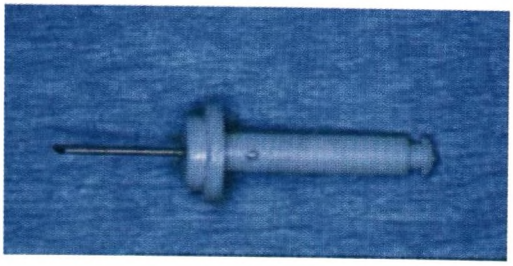


Figure 12. The perforator of the stabident.

overcome by mounting the perforator needle to a low-speed hand piece to make the perforation and a funnel-shaped needle guide is then inserted to guide the anesthetic injection needle into the cancellous bone. Therefore X-tip and Intraflow systems are more suitable to use in sites with alveolar mucosa (sites of horizontal bone loss and lack of keratinized gingiva).

X-tip™

Similar to Stabident, X-tip (Fig 13) also consists of 2 parts, the drill and the guide sleeve

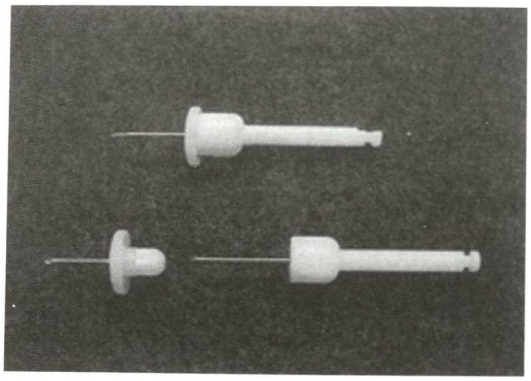


Figure 13. The X-tip™ consists 2 parts: the drill (a special hollow needle) and guide sleeve component (bottom).

(cannular guide). In X-tip system after making the perforation removal of the perforator needle leaves a cannular guide, a hollow needle in the bone to guide the injection needle to the cancellous bone. X-tip system is effective in areas that lack attached gingiva and horizontal bone loss. Advantages of the system include easy access, inexpensive start-up cost and proven effectiveness by many users.

Intraflow system™

IO injection by Intraflow system (Fig. 14) is a one step technique. Intraflow system uses a slow-speed handpiece with a needle (perforator) and a transfuser, resulting in penetration of the bone and flow of anesthetic without a separate step. This technique uses a foot pedal to regulate the flow. Advantages of Intraflow are, it works in difficult access areas or areas not localized to attached gingiva and less time consuming as it does not require the relocation of the perforation

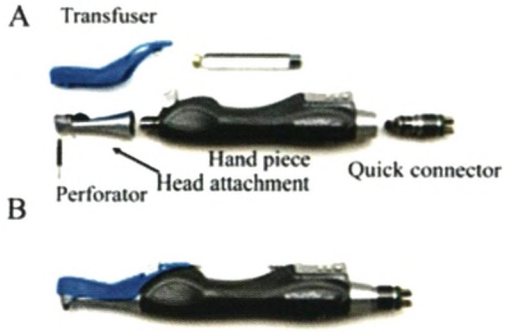


Figure 14. Intraflow handpiece dissembled (A) and assembled (B).

site. High cost compared to the other two is the main disadvantage of Intraflow system.

Summary

Local anesthetics are the most used drugs in dental profession. One disadvantage of intraoral local anesthesia is the patient's fear of injections and the perception that injections are painful. Recent advances in computer-controlled local anesthetic delivery systems are able to lessen the pain and the discomfort associated with injections. Therefore most of the time the patient does not know that the doctor has given the injection making him/her to ask "Doctor when are you going to give me the injection". So that the doctor can happily answer "Mr./Ms. patient, I have already given you the injection" making the patient as well as the doctor happy. But what might be next on the lead for dental anesthesia? Since erbium laser is used for cavity preparations, pulp therapy, and stainless steel crown preparations, dental lasers are a promising target. Hence there will be a time that patients experience painless dentistry without a needle or a drill which is truly amazing.

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Research Article I

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Hand Hygiene and Dental students / surgeons

J.A.M.S. Jayatilake, R.W. Pallegama, E.A.D.J.S. De Alwis

Abstract

Objective: Hand hygiene (HH) is a key element in infection control. This study aimed to assess the knowledge, attitudes and practice regarding Hand Hygiene (HH) among the dental students in clinical years and dental surgeons, working in the Dental (Teaching) Hospital, University of Peradeniya, Sri Lanka.

Materials and Methods: A cross-sectional survey was performed using a self-administered questionnaire. Scores obtained by the participants in knowledge, attitudes and practice regarding HH were compared among groups and associations were explored statistically.

Results: Third (n=51) and fourth (n=49) year dental students and dental surgeons (n=43) participated in the study. In the total sample, there were significant positive correlations between knowledge and practice (r = 0.2; P = 0.04), knowledge and attitudes (r= 0.4; P = 0.001) and attitudes and practice (r = 0.2; P = 0.03). Significant positive correlations existed between knowledge and attitudes in all three groups. However, correlations between knowledge and practice and attitudes and practice in the fourth-year students and the dental surgeons were insignificant. Comparison of the means revealed no significant difference in the scores of knowledge, attitudes and practice among the three groups. Knowledge and attitude scores regarding HH of the females were significantly higher than the males (P = 0.04, 0.02).

Conclusions: Overall, knowledge, attitude and practice regarding HH among the dental students in clinical years and the dental surgeons in our sample are positively correlated and the scores are comparable among groups. Knowledge in HH correlates well with the attitudes rather than practice of HH. Female participants are likely to have superior knowledge and attitudes regarding HH.

Key words: Dental students, Dental surgeons, hand hygiene, infection control

Introduction

Hand hygiene (HH) defines several actions including hand washing, antiseptic hand wash, antiseptic hand rub and surgical hand antisepsis designed to decrease the hand colonization with transient microflora.[1] Proper HH is vital in the prevention of cross infections and it is one of the key elements in infection control in various health care settings such as, clinics, wards and intensive care units.[2-4] HH has also been defined as the simplest action that helps achieve the objective of the global patient safety challenge

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"clean care is safer care".[5] However, compliance among health care personnel to recommended guidelines of HH is often poor.[2-4] For this reason, knowledge, attitudes and practice regarding HH have been extensively explored in many health care settings. For instance, a cross-sectional study using an anonymous questionnaire and individual observation has revealed that the practice of HH in physicians of numerous medical specialties is associated with the knowledge and attitudes regarding HH.[4] Nevertheless, there are only a few studies that have explored the HH among dental health care personnel (DHCP) and dental students.[6] Appropriate HH is extremely important in clinical dentistry as DHCP and patients are exposed to blood, saliva, secretions and aerosols that facilitate transmission of pathogens through direct or indirect contact.[7] Assessment of the knowledge and attitudes of DHCP regarding HH would help design methods for promotion of good and safe practice. Therefore, the objective of this study was to assess knowledge, attitudes and practice of HH in the dental students undergoing their clinical training and the dental surgeons working in the Dental (teaching) hospital, Peradeniya.

Materials and methods

Setting

Peradeniya Dental (Teaching) Hospital serves as the only institution in Sri Lanka where dental undergraduates are trained. In the Sri Lankan dental curriculum, students are exposed to clinical dental practice during the third and fourth years where they have direct interactions with the patients. HH is taught under infection control, in the second academic year and its clinical importance is reiterated during the third and the fourth years. In addition to dental students, dental surgeons are attached to this tertiary health care facility to treat the patients.

Ethical clearance for the study was obtained from the Research and Ethical Committee of the Faculty of Dental Sciences, University of Peradeniya, Sri Lanka.

Design

A cross-sectional survey was performed among the third and the fourth year dental students using a pretested self-administered questionnaire in August 2011. Same questionnaire was given to a group of dental surgeons working in the dental hospital and the data was collected. Responses were statistically analyzed usingSPSS 11.5 statistical software.

Study sample

Participants were recruited to the study using convenient sampling. The questionnaire was distributed among the dental students at the end of a lecture without a prior notice. It was administered to the dental surgeons at the completion of their daily work. All participants were requested to complete the questionnaire anonymously and hand it over to the investigators on site.

Development of the questionnaire

Questionnaire was developed according to the HH guidelines formulated by the World Health Organization (WHO) and the Centers for Disease Control (CDC).[1,7,8] Four paged close-ended questionnaire collected demographic data and assessed knowledge, attitudes and practice regarding HH as different components. Demographic data included the gender and the year of study/practice. The Knowledge-component comprised of ten true or false multiple choice questions and assessed the knowledge regarding the definition of HH, indication and benefits of HH, transmission of pathogens via hands, and the pros and cons of different HH practices. On this scale, each question had five responses and the maximum score possible was 50, with higher scores indicating possession of higher knowledge. Attitudes and practice components comprised of five-point Likert scales on which 1 was equated with "strongly disagree"or "never"and 5 was equated with "strongly agree" or "always" respectively. Attitudes component (18 items) were assessed on areas such as priority of needs, patients' needs and their awareness on HH, role/ image of the DHCP, personal habits and the fa-

cilities and the peer influence. HH practice component (10 items) assessed when, how, where HH is performed and the indications and adherence to perform HH. The items on attitudes and practice were reverse scored where necessary so that a lower score represented higher negativity. Thus, the maximum possible scores on attitude and practice components were 90 and 50 respectively.

A panel of experts consisting of three microbiologists (medical microbiologist, oral microbiologist and a general microbiologist) was used to achieve the judgmental validity including face validity, content validity and the consensual validity of the questionnaire. They assessed the tool for its relevance in assessing knowledge attitudes and practice of HH, appropriateness of wording used, acceptability by the study population. An average score of 7 out of 10 was selected as satisfactory. Necessary amendments were made according to the suggestions given by the expert panel.

Then, the questionnaire was given to 5 participants each from the 3rd year, 4th year dental students and the dental surgeons and they were asked to respond. Based on their feedback, some questions were modified to increase the clarity and accuracy. The pilot testing helped to determine acceptability, comprehension, clarity, sequencing of questions, ease of administration and the average time required to complete the questionnaire. Further, the willingness to participate and the overall feasibility of conducting the study were also assessed in the pilot test.

Data analysis

The data was explored using explorative statistics, the distributions were assessed with the graphical methods and Shapiro-Wilk test, and descriptive statistics were calculated. Correlations among knowledge, attitude and practice were determined using nonparametric correlations with Spearman correlation coefficient. Mean-scores of knowledge, attitudes and practice in the whole population were compared using the Kruskal Wallis test. Mean-scores of knowledge, attitudes and practice between males and females of the total population were compared using the Mann Whitney U test.

Moreover, knowledge, attitudes and practice were categorized into "low", "moderate" and "high" based on the distribution of the total scores achieved by each participant. Low, moderate and high categories with reference to knowledge and practice represented scores below 25, 25-35 and above 35 respectively. Low, moderate and high categories with reference to attitudes were scores below 35, 35-65 and above 65 respectively. Frequencies regarding the above categories were also determined for the whole study sample.

Results

Altogether there were 153 participants and ten questionnaires were answered incompletely. Consequently, 143 questionnaires were included in the final data analysis. Among the participants, there were 51 dental students from the third year, 49 dental students from the fourth year and 43 dental surgeons. Their gender distribution is given in the table 1. Mean scores with reference to knowledge attitudes and practice of HH are shown in the table 2.

In the total sample, there were significant positive correlations between knowledge and practice ($r = 0.2$; $P = 0.04$), knowledge and attitudes ($r= 0.4$; $P = 0.001$) and attitudes and practice ($r = 0.2$; $P = 0.03$). Remarkably, significant positive correlations were found between knowledge and attitudes in all three groups. However, correlations between knowledge and practice and attitudes and practice in the fourth-year students and the dental surgeons were insignificant. Comparison of the means revealed no significant difference in the scores of knowledge, attitudes and practice among the three groups. Knowledge and attitudes scores regarding HH of the females were significantly higher than the

males (P = 0.04, 0.02). Large proportions had moderate to high levels of knowledge (88.8%) attitudes (95.2%) and practice (99.3%) regarding HH.

Table 1. Gender distribution in the study population.

Group	Total participants	Male%	Female%
Third year dental students	51	29.4	70.6
Fourth year dental students	49	44.9	55.1
Dental surgeons	43	32.6	67.4

Table 2. Mean scores with reference to knowledge attitudes and practice of HH in the study population.

Group	Mean scores		
	Knowledge*	Attitudes*	Practice*
3rd-year students	31.9±4.9	62.5±11.4	40.8±6.7
4th-year students	30.3±5	59.8±14.9	42.3±4.6
Dental surgeons	32.4±4.9	66.4±6.7	40.3±5

(*P> 0.05)

Table 3. Frequencies obtained with reference to low moderate and high categories of the variables (knowledge, attitudes and practice) in the total study sample.

Variable	Number of respondents		
	Low	Moderate	High
Knowledge	16(11.2%)	100 (69.9%)	27(18.9%)
Attitude	7(4.9%)	69 (48.3%)	67 (46.9%)
Practice	1(0.8%)	16(11.2%)	126(88.1%)

Frequencies obtained with reference to low moderate and high categories of the variables (knowledge, attitudes and practice) in the whole study sample are displayed in table 3.

Adherence to HH on certain particular occasions where it is indicated according to the WHO guidelines was also investigated for the whole population. Accordingly, 31(21.7%) and 95(69.9%) always performed HH before and after contacting their patients respectively. Moreover, 32(22.4%) and 96(67.1%) always performed HH before donning gloves and after removing gloves correspondingly.

Discussion

Although maintaining HH is a simple, economical but a leading approach to control infection transmission, promotion of HH is a complex issue due to many factors.[3] Among a number of factors that influence practice of adequate HH including, personal demography, work load, peer influence, institutional resources and climate, other individual factors such as knowledge, attitudes, beliefs and perceptions play important roles. Interestingly, our data demonstrate that the knowledge, attitudes and practice regarding HH are positively correlated exhibiting the interrelationship among the three variables. It is also in agreement with the hypothesis that knowledge attitudes and practice are a triad of interactive factors that are uniquely interdependent.[9] Besides, these observations show that

the knowledge attitudes and practice regarding HH in the whole population follows the theory of planned behavior in which behavior can be predicted from the attitudes, subjective norms and perceived behavioral control.[10]

Noticeably, above observations were not seen when the study population was assessed in groups. Knowledge and attitudes showed a significant positive correlation in all three groups supporting the notion that knowledge plays an important role in developing good attitudes regarding HH. Third year students resembling the total population had significant positive correlations among all three variables; knowledge, attitudes and practice. However, the fourth year students and the dental surgeons, when considered separately, had significant positive correlations only between knowledge and attitudes regarding HH. Fourth year students and the dental surgeons had significant correlations neither between knowledge and practice nor between attitudes and practice of HH. This may indirectly indicate that their practice is poorly associated with their knowledge or attitudes regarding HH. On the other hand, it is likely that their practice of HH is independent of knowledge and attitudes and basically controlled by other factors such as work load, experience, facilities and infrastructure, and system constraints.[3,4] Furthermore, only a limited association has been observed between self-reported and observed HH performance in nurses working in an intensive care unit suggesting that the self reporting may have deviations from the real practice.[11] Those investigators have postulated that actual HH behavior may be more sensitive to the intensity of work activity in the clinical setting than to internal motivational factors. Since the current study is also based on the self reported data, an observational study may be useful to ascertain the real association among the knowledge, attitudes and practice regarding HH in DHCP. It is also important to note that the third year students in comparison with the fourth year students and the dental surgeons have the fresh knowledge regarding HH which influence directly on their attitudes and practice. Continuous education programmes, workshops, lectures and work performance feedbacks would be helpful in the improvement of the HH compliance.[3,5] Therefore, current data illustrate that the reinforcement of knowledge and attitudes are vital to maintain good practice of HH.

Furthermore, our data reveal that there is no significant difference in the mean scores of knowledge, attitudes and practice regarding HH among the three groups. This demonstrates that the basic input on HH either by the curriculum or by other sources is being regular and consistent. Intriguingly, knowledge and attitudes scores of the females were significantly higher than the males indicating that the females in this study sample have more knowledge and positive attitudes regarding HH than the males.

Admirably, it is interesting to note that a large proportion had moderate to high level of knowledge (88.8%) attitudes (95.2%) and practice (99.3%) regarding HH. This shows that the knowledge, attitudes and practice regarding HH in the current study sample remains at a satisfactory level. Myers *et al.* using a postal questionnaire reported that one third of the general practice dentists in USA had limited/ moderate knowledge regarding HH and they suggested that continuous education programmes would be useful to improve knowledge, attitudes and practice on HH.[6] Alarmingly, those investigators have found that 25% of the general practice dentists in USA maintain inadequate HH.[6] On the contrary, in the current study, a large proportion (88%) has mentioned that they follow good HH practice. Some of the contributory factors for these observations are standard facilities, peer observations and continuous education programmes that are readily available in a teaching institution.[12,13]

It is also important to consider the HH practice of the participants at different clinical situations.

For example, 31 (21.7%) and 95 (69.9%) always performed HH before and after contacting their patients respectively. It has been reported that nearly 70% and 60% Iranian general practice dentists washed their hands respectively before and after treating HIV infected patients.[14] Lack of compliance with HH in the current study group could be attributable to the fact that nowadays our dental students and dentists are supposed to use disposable gloves at all patient contacts. On the other hand, these students are mainly exposed to routine dental patients who are otherwise healthy. Moreover, 32(22.4%) and 96(67.1%) of the current study population always performed HH before donning gloves and after removing gloves respectively. Thus, there are considerable proportions that do not practice HH properly putting patients and themselves at a risk of cross infections. Nevertheless, 11% of general practice dentists in USA have reported that they never perform HH in the dental clinic after removing gloves.[6] Conversely, in our case, a satisfactory proportion (67.1%) has mentioned that they perform HH after removing gloves. However, in a study to assess the HH practice in health care workers when they used gloves Fuller *et al.* have observed that glove use reduced the levels of good HH practice.[15] Therefore, proper HH after undoning the glove is greatly advisable to get rid of the smear that leaks into hand through the micro perforations in the glove.[1,8] Taken together, it is important to educate the study participants regarding the proper use of gloves and it should be stressed that gloves are not an alternative for HH.[1,8]

In Dentistry, operator's hands are often exposed to the site of operation, where chances of transmission of infections are relatively high. Moreover, numerous sharp instruments such as dental forceps, needles, scalars, curettes, burrs and root canal files may also increase the risk of unintentional trauma to the operator and the patient. Thus, HH for DHCP could be considered as a corner stone in achieving infection control in dentistry. Failure in good HH may increase the vulnerability for transmission of infections. Therefore, it is important to cast attention on HH in dental curricular and to keep up the continuous education throughout.

To conclude, our study demonstrates significant positive correlations among knowledge, attitudes and practice regarding HH in clinical dental students and dental surgeons and the mean-scores are comparable among the groups. Knowledge in HH correlates well with the attitudes rather than practice of HH. Female participants are likely to have superior knowledge and attitudes regarding HH. An observational study may be useful to ascertain the real associations of the above variables with reference to DHCP. Furthermore, standard facilities, peer observations and continuous education programmes available in a teaching institution which is also a tertiary care institution may have contributed a large proportions of participants to possess moderate to high level of knowledge attitudes and practice regarding HH.

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Mini Review & Case Report

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Interdisciplinary Management of Bilateral Congenitally Missing Maxillary Canines: A Review and Case Report

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Abstract

Hypodontia or congenital absence of teeth is one of the most common polymorphisms in humans. However, literature reveals that permanent maxillary canines are missing rather infrequently, unless when multiple teeth are absent as in the case of certain syndromes such as ectodermal dysplasia. When permanent canines are 'exclusively' absent in the mouth, and the deciduous predecessors are present or have exfoliated, more often than not they are impacted rather than missing. Consequently, bilateral occurrences of congenitally missing permanent maxillary canines are extremely rare, and there had been only a very few such cases reported in the world.[3-5]

Importance of the maxillary canines for anterior dento-facial aesthetics and dynamic occlusion has been well documented in the literature. Hence the impact of missing canines on the dentition and on the affected individual cannot be understated. Yet, meticulous interdisciplinary management involving restorative and orthodontic specialties could restore aesthetics and function to a highly acceptable level.

Age of the patient and the presence of deciduous canines are the most crucial factors in determining between active intervention and conscientious monitoring. An adult patient would invariably require active intervention and the missing teeth can be replaced by means of either osseointegrated implant-retained prostheses, conventional bridges or by orthodontic repositioning of adjacent teeth. The reported case describes interdisciplinary management of a 22 year old female missing canines by orthodontic relocation of premolars to the position of canines and subsequent replacement of the former with cantilever resin bonded bridge prostheses.

Key Words: Bilateral Missing canines, Hypodontia, interdisciplinary management

Introduction

One of the most common polymorphisms in humans is 'hypodontia', or the congenital absence of teeth. According to the number of missing teeth, it has been further classified into hypodon-

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tia, oligodontia and anodontia, when a person is missing less than six, more than six or all the teeth respectively.[1] In Caucasian populations, prevalence of congenitally missing permanent teeth varies from 1 to 10.1%, with a female to male ratio of 3:2.[1] Yet excluding, third molars, the prevalence can be identified as 3.5 to 6.5% .[2] Predilection of teeth by the order of most to least frequently missing is reported as; third molars, mandibular second premolar, maxillary lateral incisor, mandibular incisors and maxillary second premolar teeth. Missing maxillary central incisors and canines are extremely rare, and it is usually associated with syndromes affecting multiple teeth.[1] Literature regarding 'exclusive aplasia' of maxillary permanent canines is very scarce, especially in relation to bilateral occurrences and only a very few such cases have been reported,[3-5] and there had not been any such cases reported from Sri Lanka.

Maxillary canines have stout crowns, and the longest, sturdiest roots in the dentition.[6] These unique teeth have important roles in dento-facial aesthetics and in orofacial functions. From the facial aspect, they are precisely positioned, where the dental arch curves backwards. Thus only a part of the canine is visible from the front view. As a result, bilateral negative spaces (Dark -buccal corridors) are evident during a relaxed smile, which provide cohesiveness to the dento-facial composition.[7] Maxillary canines also have specific dimensions and angulations for aesthetic harmony across the anterior teeth. History reveals that the search for exact mathematical concepts to define beauty, led to the discovery of 'Divine (Golden) proportions' by Pythagoras in 530BC. He stated that an object with 1/1.618 ratio has innate beauty, and when it's repeated across objects there is aesthetic harmony. This has been successfully transposed to the maxillary anterior sextant by Lombardi, in which this ratio is evident, in relation to the mesio-distal widths of ipsilateral central incisor, lateral incisor and canine teeth, as seen from the frontal view.[8]

The function of maxillary canines is not limited to tearing of food, as commonly thought. They have a more important role in dynamic occlusion and relatedly, in lateral excursions of the mandible, in about half of the population, anterior guidance is provided exclusively by canines.[9] Their palatal morphology is optimally contoured to provide a mutually protected occlusion, while their long, sturdy roots can withstand and transmit heavy excursive forces to nasomaxillary buttresses.

Depending on the number of teeth missing and whether both primary and permanent dentitions were involved, hypodontia could give rise to varying degrees of functional and aesthetic impairments. Unaesthetic spacing and centerline shifts are common findings, even when a single tooth is missing. Functionally, the absence of anterior and posterior teeth will give rise to speech problems and reduced masticatory efficiency respectively. The psychological impact of hypodontia is often overlooked, primarily due to the difficulty in assessing it. Children with missing teeth have been found to have increased emotional stress and low self-esteem, and are subject to frequent teasing and bullying.[10]

Interdisciplinary management is recommended for virtually every patient with hypodontia and a case of missing canines is no exception. This frequently involves collaborative efforts of orthodontics and restorative dentistry specialties with involvement of maxillo-facial surgeons where necessary.

The following case describes an interdisciplinary management of a patient with bilateral congenital missing permanent maxillary canines, by synchronous application of orthodontics and restorative dentistry techniques.

Case Report

A 22-year-old female from Gampola, Sri Lanka, presented to the Department of Restorative Dentistry, Faculty of Dental Sciences, University of

Peradeniya, complaining of 'wobbly milk teeth' in the 'front' of her mouth. She was aware that her deciduous canine teeth had not been replaced with permanent successors. These had first become mobile 6 months ago, and as a temporary measure, they had been bonded to the adjacent teeth by a general dental practitioner upon request. However, there had not been any pain or discomfort. She had neither significant medical history and nor was she on any medication. With the exception of immobilization of primary canines her past dental history was uneventful. Her dietary habits and oral hygiene practices were ordinary and she had no detrimental habits. She was unmarried and highly motivated on improving her aesthetics.

On examination, she was healthy-looking with no extra-oral abnormalities. Intra-oral examination revealed healthy soft tissues (Basic periodontal examination (BPE) scores were <2) and a full complement of teeth, except the third molars. However, instead of permanent maxillary canines she had deciduous counterparts. The dentition was sound with the exception of 53 and 63 which were critically mobile (degree-3). The restorative material that had been used to bond canines to adjacent premolars had fractured (Figure-01). The permanent canines were not palpable in the buccal sulcus.

There was mild crowding in the maxillary arch, considering the potential size discrepancy of permanent and deciduous canines. Maxillary incisors were retroclined and compared to those, lateral incisors were disproportionately narrow (Figure-01,02). Mandibular arch exhibited moderate and mild degrees of crowding on left and right sides respectively (Figure-03). Arches together, she had a class II division 2 malocclusion, according to the BSII (British Standards Institute's Incisor) classification. She had no deviation of the mandible in opening or in protrusion and was having group function on both sides on lateral excursions.

Area specific intra-oral periapical radiographs, and an upper standard occlusal radiograph were requested. Interestingly, 53 and 63 roots have been completely resorbed despite 13 and 23 being missing on radiographs (Figure-04, 05-R, 05-L). Pulp sensibility testing on adjacent teeth gave positive responses. Clinical photographs and impressions for study casts were also obtained for space analysis and recording purposes.

Figure 1. Pre-treatment Frontal view (Deciduous canines bonded to Premolars)

Figure 2. Pre-treatment Occlusal view –Maxillary arch

Figure 3. Pre-treatment Occlusal view-Mandibular Arch

Figure 4. Upper Occlusal radiograph (Missing permanent canines)

Figure 5L. IOPA radiograph showing 'Left' retained deciduous canine

Figure 5R. IOPA radiograph showing 'Right' retained deciduous canine

Figure 6. Cephalometric analysis

Figure 7. Full fixed orthodontic appliances

Based on the history, clinical examination and special investigations, a diagnosis was arrived at as "bilateral congenitally missing permanent maxillary canines, with class II division 2 malocclusion, and mild maxillary and moderate mandibular crowding".

The following management plans were formulated with the participation of representatives from other dental disciplines and were presented to the patient, along with complete details of their benefits, potential complications and estimated time and costs involved.

1. Extraction of 53, 63 and replacement of missing 13 and 23 with prostheses; accept the malocclusion and potentially small canine prostheses.

2. Orthodontically reposition first premolars to the space of the canines; replace the premolars with prostheses; correct the malocclusion

The prosthesis had to be selected from implant retained fixed prosthesis, removable partial denture, fixed partial denture (conventional), precision attachment retained prosthesis and resin bonded (adhesive retained) prosthesis.

On the next visit she informed that she wanted to proceed with the second option, and she also requested a fixed prosthesis but decided against implant treatment. Consequently, she was referred to the Division of Orthodontics. Subsequently orthodontic assessment and cephalometric (Figure-06) and space analyses were carried out, and a treatment plan was formulated in the following sequence.

- Preventive phase - reinforce plaque control measures
- Orthodontic Phase - relocation and orientate maxillary first premolars to resemble canines, correction of incisor relationship; relief of crowding.
- Preliminary restorative intervention - removal of primary canines and re-contouring of 12 and 22 to the correct proportions
- Reassessment - plaque control, aesthetic and occlusal assessment
- Definitive restorative treatment - resin bonded cantilever bridges to restore spaces in relation to 14 and 24.
- Review phase

Patient was educated on the importance of oral hygiene measures, and full fixed orthodontics was commenced (Figure-07). The deciduous

Figure 8. Re-contoured lateral incisors

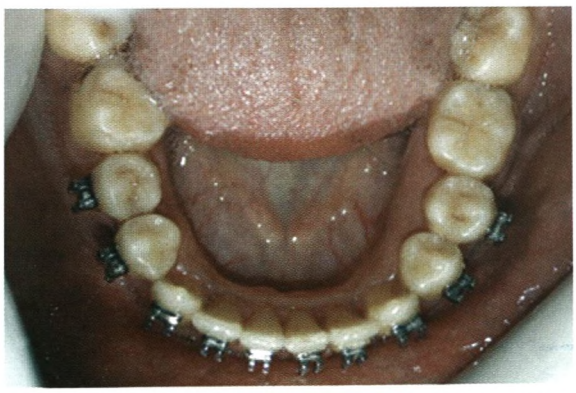

Figure 9. Completed orthodontics - Mandibular Arch

canines were conveniently extracted and spaces thus created in between 12-14 and 22-24 were gradually relocated to 14-15 and 24-25. A pair of brackets designed for canines were placed at a slightly disto-gingival position on 14 and 24, to apply forces that would ultimately orientate them in the arch, to resemble canines in all three dimensions. Moreover, during this movements, distal aspects of maxillary lateral incisors had to be built up with composite (3M ESPE, USA), to allow the orthodontist to move premolars until they made contact with them. The precise width of the lateral incisors was calculated using the 'divine proportions' as described by Lombardi (Figure-08).

The patient was reviewed to reinforce plaque control measures at every other orthodontic appointment. Upon completion of the orthodontic phase (Figure-09), bonded retainers were placed palatally and lingually for retention. A maxillary removable acrylic space maintainer was also constructed and delivered (Figure-10). Impressions were made of post-orthodontic dental arches with alginate (Aroma Fine DF II, Fuji, Japan), and cast in dental stone. A reassessment of occlusion was carried out using new casts mounted on an articulator with diagnostic wax mock ups. It was decided to construct cantilever resin bonded bridges, with retainers on second premolars. Retainers were designed to cover the entire palatal cusps and half of the occlusal surface of the buccal cusp, with an anti-rotation groove on mesial aspects.

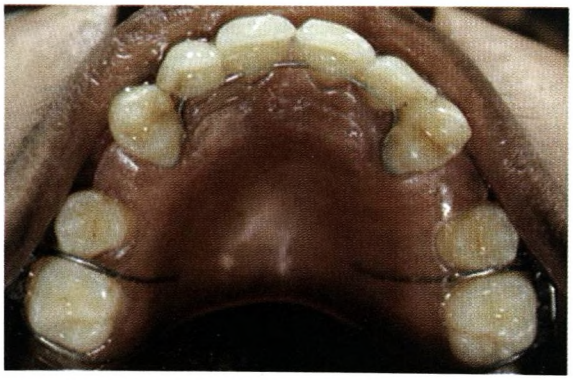

Figure 10. Removable acrylic space maintainer

Figure 11. Post-treatment Occlusal view (Resin bonded cantilever bridges in situ)

Figure 12. Post-treatment Lateral view

Figure 13. Post-treatment Frontal view

On the next visit, intra-enamel preparations were carried out on 15 and 25 and an impression was made in addition cured silicone (Ormaplus, Major Dental, Italy). The composite restorations of 12 and 22 which had been placed to guide orthodontics were refined and polished, to get optimal contact points and embrasures between lateral incisors and premolar teeth. The final prostheses were cemented with resin cements (RelyX, 3M, USA) (Figure-11). The occlusion was assessed to confirm group function in lateral excursions and absence of interferences in protrusion (Figure-12). Patient's approval was obtained about ultimate comfort and aesthetics (Figure-13).

She was reviewed after one week, in one month and at 3 month intervals afterwards. At every review oral hygiene instructions were reinforced and stability of the prosthesis was confirmed. She is satisfied with the final outcome and was keen on maintaining her improved oral health status.

Discussion

When a patient past the general eruptive age of canines, with no history of extractions and no palpable canine bulge presents with retained deciduous canines, ectopic eruption or aplasia of permanent canines must always be suspected. Due to the relatively increased incidence of ectopic eruption of the permanent canines, primary canine is the most commonly found retained deciduous tooth.[4] Therefore, at the very outset it must be confirmed whether permanent canines are ectopically placed or missing.

The principles of management of missing canines, to a greater extent resemble those of mild hypodontia. A thorough history and a clinical examination must be carried out, to find whether any additional teeth are missing, and to exclude the possibility of tooth loss due to extractions or trauma. Appropriate referrals to physicians and geneticists may also be required to exclude association of syndromes. Radiological investigations are mandatory to differentiate missing from ectopically placed teeth. Study casts are invaluable for space analysis, for diagnostic wax-ups and to monitor the progress of treatment. Ideally, a specialist team managing hypodontia includes prosthodontists and orthodontists, with involvement of paedodontists, psychiatrists and oral surgeons depending on the clinical scenario.[1] Condition of the retained deciduous teeth, patient age, expectations, financial limits, the status of rest of the dentition and level of plaque control, could significantly influence not only formulation of a management plan but also its execution.[2]

In a young patient, if deciduous canines are having good prognoses, they can be retained and monitored until they naturally exfoliate. This is a viable treatment option allowing the patient and his/her family to make a decision and present at a later time.[4] This is also advantageous especially when future osseointegrated implant retained prostheses (IRP) are envisaged, as for implant placement, the patient's growth should be complete and adequate amount of bone must be available. However, these teeth can wear off occlusally or get ankylosed and submerged, causing occlusal disharmonies such as tilting of adjacent and supra-eruption of opposing teeth.[1] In addition they are not very suitable as bridge abutments due to their short clinical crowns. Several techniques have been suggested in the literature to minimize these drawbacks. Composite re-contouring and incremental building of its occlusal surface can overcome the aesthetic and occlusal issues. In addition, root canal treatment, especially with mineral trioxide aggregate (MTA), has shown to delay the rate of root resorption of the retained primary teeth.[11]

If the deciduous counterpart is lost, or is of dubious prognosis, or when an adult patient requests a more durable definitive restoration, intimate liaising between different dental disciplines becomes even more critical. There will be horizontal or vertical space loss across the dental arch as a result of tilting, drifting or supra-eruption of teeth into the space previously occupied by

the deciduous teeth. A decision must be made whether to accept, close or redistribute the space.[12]

When there is minimal spacing, it can be accepted, if the patient is not concerned about its aesthetic impact or is unwilling to undergo corrective orthodontic procedures. While this is acceptable in relation to posterior spaces, anterior spaces may have to be eliminated with composite or porcelain veneers, with the aid of diagnostic wax mock ups.

Closing the space is possible in certain mild hypodontia cases, eliminating the need for a prosthesis and its life-long maintenance.[12] In patients where dental arches exhibit concurrent spacing and crowding or when there is already a space requirement for correction of a malocclusion this approach is recommended, as fixed orthodontics can close the spaces and correct mal-alignment at the same time.[13] Nevertheless, even though a prosthesis is not required, restorations may still be needed to improve aesthetics. (e.g. re-contouring of a canine to mimic a missing lateral incisor)

When multiple teeth are missing, in different parts of the mouth, the resultant edentulous spaces may not be ideal for replacement of morphologically accurate teeth, as in the case described here. Using fixed orthodontics, teeth can be moved to re-distribute the space for optimal prosthodontic rehabilitation. A diagnostic wax-up is a prerequisite to confirm the position and the orientation of abutments. Despite these functional and aesthetic advantages, this approach commits the patient to a permanent prosthesis.[12] Moreover, if implants are being considered in the future, time-consuming orthodontic movements such as translation or torque, instead of tipping movements are required, to make roots of the teeth adjacent to edentulous area parallel or slightly divergent.[13]

The decision about the final prostheses was already made during the planning stage. These were broadly classified into removable or fixed prostheses, supported either by osseointegrated implants or natural teeth abutments. Osseointegrated implant retained prostheses (IRP) are currently the treatment of choice for replacement of single missing teeth.[12] They are completely independent of other teeth yet expensive and would warrant lengthy treatment times, refined orthodontics and further surgeries such as ridge augmentations. A removable partial denture (RPDs) is the most versatile and the cost-effective treatment option. However, they occupy more space in the mouth than what needs to be replaced, which in turn could damage the remaining natural teeth and gingivae with time. Since most patients who present with hypodontia are young patients, their general aversion towards removable prostheses have made RPDs, a viable interim rather than a definitive prosthetic option. Edentulous spaces of a patient with hypodontia can also be restored using precision attachment retained prostheses or a fixed partial dentures (bridges). These are ideally constructed for short-span bounded saddles. Their major drawback is the need for extensive irreversible preparations of mostly sound abutment teeth.[12] Resin bonded bridges (adhesive retained prosthesis) are comparatively very conservative and most require minimal intra-enamel preparations. Furthermore, recent advances in adhesive resin cements have greatly improved their survival rates.[14] However, it is still less durable than conventional bridges especially in areas subjected to high occlusal loads. Auto-transplantation of teeth to edentulous spaces has also been reported in some patients with hypodontia.[15] Mandibular second premolar is the most valuable tooth for transplantation into maxillary anterior spaces. Atraumatic removal of the tooth without damage to its periodontal ligament is imperative to prevent ankylosis or resorption following transplantation. While it is axiomatic that a prosthesis may not be necessary afterwards, the transplanted tooth would still require composite re-contouring, bleaching and gingivoplasty

to resemble aesthetics of the particular tooth it replaced.

Provision of a prosthesis to replace the missing canines was the most straightforward management option for this patient. An implant retained prosthesis was unfeasible due to her unwillingness for surgical procedures. The options of conventional or adhesive retained cantilever bridges to replace canines were also discarded, as pontics unlike roots, would simply lie on the alveolar ridge and would neither create canine eminences nor transmit occlusal forces adequately. In addition, her incisor malocclusion and the crowding would have to be accepted. Since the patient also expressed her wishes to get her malocclusion corrected, these options were rejected.

The second option was to orthodontically reposition the first premolars into the position of the permanent canines. With full fixed orthodontic therapy, her class II division 2 malocclusion and varying degrees of crowding, could also be addressed simultaneously. Studies have shown that there is no long term periodontal or occlusal damage, to a first premolar occupying the canine position or to any of the adjacent teeth, with adequate function being obtained.[16]

There are several modifications in the orthodontic treatment to orientate the premolar to mimic a canine, because compared to canines, premolars are narrower and have two cusps and a more coronal gingival margin. On the horizontal axis an orthodontic bracket was placed slightly distally to encourage mesio-palatal rotation of the premolar. This hid the palatal cusp from view and increased the mesio-distal width of the tooth. On the vertical axis, bracket could be placed either gingivally or occlusally than the normal central position, depending on the clinical situation. Gingival placement of the bracket would extrude the tooth, lengthening it and achieving good occlusal contacts. In addition it will also produce a buccal root torque which will create a canine eminence and lift and conceal the palatal cusp. However, extrusion could bring down the gingival margin and to a certain extent the palatal cusp. In contrast, if the bracket is placed at a more occlusal position, the tooth will intrude raising the gingival margin and the palatal cusp along with it. However, composite restorations would be required to restore crown height and occlusion, despite the fact that palatal root torque could move the palatal cusp more occlusally. Therefore, the ideal orientation of canines must be decided individually for each patient, based on occlusal requirements and gingival aesthetics.[17]

Full fixed orthodontic treatment, on this patient relocated the maxillary premolars and corrected her anterior malocclusion on both arches simultaneously. Orthodontic brackets designated for canines were placed on premolars at a more disto-gingival location to apply forces and torqueing movement similar to those on canines. Consequently, some degree of mesio-palatal rotation to broaden the tooth, buccal root torque to simulate canine eminence and concealing of the palatal cusp were achieved. The relief of crowding not only improved aesthetics but also made her dentition readily cleansable to minimize risk of development of caries and periodontal disease. However, gingival margins of the relocated premolars had to be accepted at a more occlusal/incisal position. Preparations for retainers for the resin bonded cantilever bridges were kept intra-enamel with maximum coverage of palatal cusps. These preparations were optimum since adhesive resins have much higher bond strengths to enamel than to dentine and palatal full coverage design increases the surface area for retention.

Conclusion

Bilaterally congenitally missing maxillary canines are a rear occurrence, yet its management doesn't vary markedly from that of mild hypodontia. This case described a female patient with a similar condition who was successfully managed using a multidisciplinary approach,

incorporating various techniques of restorative dentistry, orthodontics and prosthodontics.

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Case Report II

Sri Lanka Dental Journal 2013; 43(02) 98-103

Solitary Fibrous Tumour: a rare tumour

W.P.K.K. Wijayalathge, S.P.I. Silva

Abstract

Solitary fibrous tumour (SFT) is a rare spindle cell neoplasm which was initially described as pleural based tumours. Later it was diagnosed in many extra pleural locations including head and neck region, but intraoral SFTs are very rare.

It may occur in buccal mucosa, palate, tongue and lips etc. and clinically appears as other common intraoral tumours like salivary gland tumours, lipoma, fibroma, and vascular malformations etc.

Diagnosis of SFT is by histopathology. As there are other tumours which share some histopathologic features, immunostaining (specially CD34) is used to differentiate it.

Treatment of SFT is excision with a clear margin. As 20% - 23% of pleural SFTs show malignant behavior with local recurrence and regional lymph node metastasis, close follow up is mandatory.

We report a case of SFT in buccal mucosa of a 60 years old man which was excised successfully after selective embolization of its feeding vessel, the left facial artery.

Key words: Solitary fibrous tumour, spindle cell neoplasm, selective embolization, CD34, CD99.

Introduction

Solitary fibrous tumour (SFT) is a rare spindle cell neoplasm which was initially described by Klemperer and Rabin[1] in 1931 as a pleural based lesion.

It was also called fibrous mesothelioma, localized fibrous mesothelioma, localized fibrous tumour, localized mesothelioma, pleural fibroma, solitary fibrous mesothelioma, submesothelial fibroma and subserosal fibroma because it was considered to be having a mesothelial origin and related to the pleura.[2]

Currently it is identified in many extra pleural locations like peritoneum, mediastinum, lungs, spinal cord, soft tissue, sinonasal tract, nasopharynx, thyroid, salivary glands and orbit.[2,3,4]

First SFT in head and neck region was published in 1991 by Witkin and Rosni.[5] Since then there are only less than 200 reported cases of SFT in head and neck region, found in English language.[6] Reported intra oral SFTs are even rarer.[5]

We report a case of SFT in buccul mucosa of a 60 years old male which was completely excised following selective embolization of the feeding artery.

Case Report

A 60 years old male was referred from District

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Dr. S.P.I. Silva BDS MS, Consultant in Oral and Maxillofacial surgery, Dental Institute, Colombo.

General Hospital Gampaha to OMF unit B in Dental Institute, with the complaint of a lump in his left side cheek and lip. He was having this painless lump for the past 12 years and it was gradually increasing in size. There was no associated numbness or pareasthesia related to the lower lip. Sudden onset bleeding episode has made him to seek medical advice. (Fig. 1- Frontal view of the patient) His past medical history was unremarkable and he has undergone dental extractions without any complication.

He was a mason by profession and married with three children. He was a nonsmoker, not a betel chewer but was a moderate alcohol consumer which he had stopped two months ago. On examination there was no sign of any systemic illness found.

There was an obvious facial asymmetry with a lump in his left side lower cheek extending to the same side lower lip region. It was arising from deep soft tissues of the buccal mucosa and about 8cm x 6cm x 8cm in size with a spherical shape. The lump was firm in consistency, with an irregular / nodular like surface and was non tender. It was freely mobile in all directions with unattached normal appearing skin and oral mucosa either side. There were no inflammatory signs. The lump was non reducible on pressure and there was no associated lymphadenopathy. There was a prominent blood vessel seen entering in to the distal end of the tumour. (Fig. 2 A closer view of the tumour)

A fine needle aspiration was performed prior to the incisional biopsy. That resulted in profuse bleeding from the lesion. A Digital Subtraction Angiograme (DSA) of left side external and internal carotid arteries was done to see the vascularity and exclude vascular malformations. Fig.4 shows the highly vascular nature of the tumour and its main blood supply from the left facial artery. The Computer Tomography (CT) in correlation with DSA findings reported it as a haemangioma of left side cheek extending to the lower lip. Fig.3 shows the axial CT scan picture at the level of maxilla. It shows the pressure erosion of maxilla and focal calcifications of the tumour. Fig.4 shows the vascular pattern in DSA study.

The surgical excision of the tumour was planned 24 hours after selective embolization of the feeding vessels. The left facial artery was selectively embolized with Gel-form particles by a guided catheter introduced via the right femoral artery. (Fig. 5 - Post embolization DSA of left facial artery showing complete cut off of blood supply to the tumour). The lesion was completely excised under general anesthesia on the following day. Fig. 6 shows the surgical specimen. The specimen was send to the Department of Oral Pathology, University of Peradeniya, where it was histologically examined especially with immunohistochemical staining for CD34 and CD99.

Histopathology Report

Well circumscribed unencapsulated tumour composed of collagenous tissue without a definite pattern. There are frequent areas of hyalinization. Residual ductal structures are evident within densely hyalinized areas. There are foci of calcifications. Some cellular areas of the tumour show myxoid changes and contain numerous blood vessels of varying size. Imunohistochemical stains for CD34 and CD99 show strong positivity. (Fig. 7 and Fig. 8)

These histopathological features together with the results of immunohistochemistry confirm the diagnosis of Solitary fibrous tumour.

Patient remained tumour free after one year post operatively.

Figure 1. Appearance of the patient from from

Figure 2. A closer view of the tumour

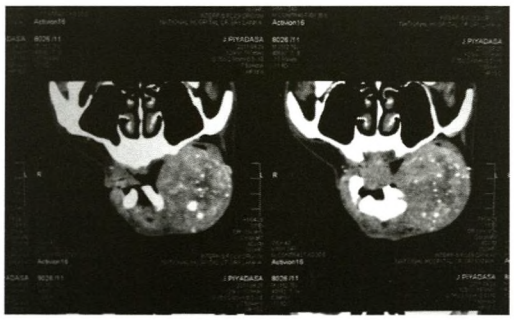

Figure 3. Coronal view of the CT Scan showing pressure erosions of left side maxilla and calcifications within the tumour.

Figure 4. Pre embolization DSA picture showing high vascularity of the tumour with its main arterial supply by left facial artery

Figure 5. Post embolization DSA picture showing complete cut off of blood supply to the tumour

Figure 6. Specimen after excision.

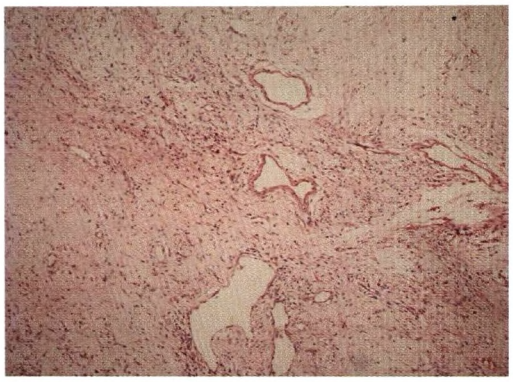

Figure 7. H and E stained section of tumour

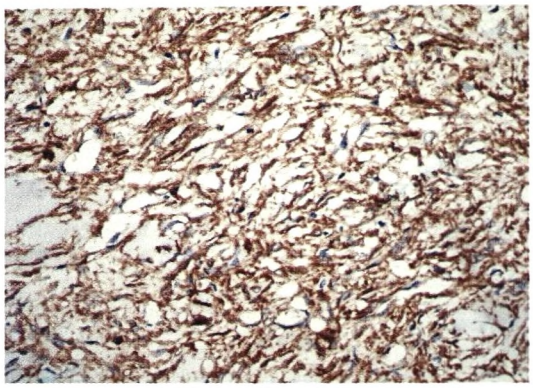

Figure 8. Immunostaining for CD34

Discussion

Solitary fibrous tumour (SFT) occurs in adults of either sex, although some authors suggest a female predilection.[3] The age range varies from 40 years to 70 years [2], but for some authors it varies from 2nd to 8th decade of life.[3] Our patient was a 60 years old male.

The reported intraoral SFTs are slow growing, asymptomatic, well circumscribed, sub mucosal masses.[2,7] In our patient also it was slowly enlarging for 12 years, and was an asymptomatic, well circumscribed, submucosal mass. More often SFTs are incidental findings that come across in routine examinations. They may grow even up to 40cm in diameter unnoticeably within the abdomen or thorax.[2] In our case it was about 8cm × 6cm × 8cm in size.

Less than 5% of SFTs are associated with finger clubbing and hypoglycaemic attacks.[2] But these are very unusual in head and neck SFTs. Our patient did have neither finger clubbing nor history of hypoglycemic attacks.

Some authors relate intra oral SFT with previous history of trauma or continuous occlusal irritation as causative factors.[3] But this patient did not give a history of trauma to his cheek and there was no irritation from teeth to the same region.

SFT is clinically mistaken for a variety of benign and malignant neoplasms due to its occurence in a wide range of locations.[8] Salivary gland tumours, lipoma, vascular malformations, fibroma, mucocele, are the main clinical differential diagnoses in intra oral SFTs.[3,7] Profuse bleeding while attempting for fine needle aspiration and DSA findings of high vascularity led us to an initial clinical diagnosis of a vascular malformation in our case. This was later supported by the CT Scan studies. Therefore we planned selective embolization of the main feeding artery (the left facial artery) of this lesion 24 hours prior to the surgery.

Diagnosis of SFT is with histology supported by immunohistochemistry. Immunostaining plays a major role in diagnosing SFT as there are many other lesions that mimic it histologically.

The histological spectrum of SFT varies from case to case and in a single case from field to field. It carries characteristic "pattern less pattern".[8] It is composed of a well circumscribed, unencapsulated, tumour with a lobulated appearance.[2,8,9] Myxoid or cystic changes, haemorrhage, necrosis, and focal calcifications may present but they are not very common.(In our case there were focal calcifications noted in CT scan report). Tumour exhibits hyper cellu-

lar (cell rich) and hypo cellular (collagen rich) areas.[2,8] The cells are short spindle or plum cells with scanty cytoplasm which may mimic smooth muscle or neural cells under low magnification.[8] There are two hypotheses regarding the origin of these tumour cells.

I) Multidirectional differentiation of fibroblasts or pluripotential mysenchymal cells. (Most supported hypothesis.[2,9]) and

II) A specialized cell that can differentiate into surface mesothelium.

The vascular pattern may mimic haemangiopericytoma like vascular pattern.[7] Chan[9] gives a detailed diagnostic criterion for diagnosis of SFT.

SFT histologically mimic a number of benign and malignant tumours like neurofibroma, schwannoma, leiomyoma, fibrohisteocytoma, spindle cell lipoma, synovial sarcoma, fibroma and haemangiopericytoma.[3] Lipomatous haemangiopericytoma, (orbital and extra orbital) giantcell angiofibroma and SFT share some common histopathological features among them. Because of this they are considered to be a spectrum of lesions which are in a common group.[2,8] Immunohistochemistry is used to differentiate SFT from the lesions which closely resemble it histologically. The principle immune marker that is used is CD34. It is a transmembrane glycoprotein on human haemtopoetic progenitor cells and vascular endothelium.[2] According to some studies CD34 is positive in 80- 95 % of SFTs, but for some authors there is 100% CD34 positivity.[2,3,8,10] About 50% show as bcl-2 positivity too.[2,3,10] CD34 is not specific for SFT but its presence with typical histological features give a solid diagnosis of SFT.

Although it is claimed to be having a myofibroblast origin, interestingly SFT is negatively stained for smooth muscle actin (SMA). This is contradictory to the currently accepted hypothesis of its origin. Presence of SMA negative subtype out of the four myofibroblast subtypes could be the answer for this.2

CT and MRI are used in assessing the extent and the relations of the adjacent structures in management of SFT. In our case CT scan report showed pressure erosions in left side maxilla resulted from the tumour, which is a very rare finding.

Although,20% - 23% of pleural SFTs show malignant features with local recurrence and metastasis to regional lymph nodes, malignant behavior is rare in head and neck SFTs. There are only very few reported cases of malignant intraoral SFTs in the literature.[9] The features of aggressiveness are more than 4 mitotic figures for a High Power Field, increased cellularity, focal necrosis and cytological atypia.[2,8,9] There are reported cases of recurrances and metastasis without the above mentioned histological features of aggressiveness.[2,11] Relevance of this in regards to the management is discussed later.

Treatments

According to the published data the accepted mode of treatment for SFT in any location is the surgical resection with a clear margin. The single most important factor in controlling local tumour recurrence and late metastasis is to have an adequate tumour free resection margin.[8] Because of this reason some authors suggest it is wise to treat all SFTs as malignant SFTs. A long term follow up is mandatory as recurrences have been reported even after five years of first surgery.

Some authors recommend chemotherapy and post operative radiotherapy for large tumours with involved margins.[9]

Although there are reported cases of preoperative selective arterial embolization in extra cranial SFTs[11] pre operative selective embolization of main feeding arteries is not much discussed in management of SFTs outside the head and neck

region. But it is a well recognized practice in intra cranial tumours. This significantly reduces intra operative blood loss, makes surgery easier by improving visualization and reduces surgical time. But it also carries a risk of high morbidity and mortality especially in the head and neck region.[12]

In our patient also we used this technique and found that it makes surgery very much easier and less time consuming.

Our patient was under close observation for more than one year and during that time there was no recurrence or metastasis observed.

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Instructions to Authors

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

1. Leading articles - One article per issue. It may be solicited by the Editor. Authors are welcome to submit leading articles on current topics of interest. One's expertise or commentaries on general practice etc. They should be approximately 1500 words in length. References should be 20 or less.

2.Reviews - Reviews are detailed surveys of published research pertinent to dentistry and associated sciences. They should be critical in nature and should not normally exceed 3000 words and 30 references.

3. Research articles - Articles resulting from research work belong to this group. Results from routine clinical examinations or laboratory investigations will not be considered under this category. Subjects may vary from clinical trials to basic science research, historical analysis to dental economics. They should not exceed 3000 words and 30 references. A reasonable number of tables and illustrations will be accepted.

4. Short reports - These include reports on current topics, modified techniques. new materials, practice management etc. Interesting results from routine, clinical work or laboratory ill vestigations also may be accepted.

5. Case reports - Reports such as of rare diseases or conditions. Modifications to accepted treatment procedures, new management methods etc. may be included in this category.

6. Letters to Editors - Subjects unlimited, but may include short critique of published papers in the SLDJ.

7. Miscellaneous topics - Subjects unlimited and the format are free. These may also include details of scientific meetings, conferences, annual sessions, examinations, news and views, visits and obituaries.

8. Proceedings of annual sessions - Abstracts from annualsessions of the SLDA and other colleges will be published under this category.

Submission of manuscripts

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

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

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

Manuscript style

The manuscripts should be typed, double-spaced: on A4 (2 I 2x297 mm) paper and submitted in correct English: both English and American spelling are acceptable, provided this is consistent throughout the manuscript.. Manuscripts not submitted in proper format or in poor English may be returned without review. The format of a manuscript should be as

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

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

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

I) Objective: An introductory sentence indicating the objective and purpose of the study.

2) Material and methods: A description of experimental procedure including applicable statistical evaluation.

3) Results: A summary of the new. Previous unpublished data and results.

4) Conclusion: A statement of the study's conclusion 3-5 key words according to Index Medicus should be provided.

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

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The authors should consider the ethical aspects of their research and ensure that the work has been approved by an appropriate Ethical Committee. Where applicable, a copy of the ethical clearance certificate should be attached. In human experimentation. informed consent from individuals should be Obtained and this should preferably be stated.

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

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

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

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

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

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

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

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

Journals

Standard journal article

Bartlett IG, O'Keefe P. The bacteriology of the perimandibular space infections. JOral Surg 1979; 37: 407409.

Corporate (collective) author

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

Unpublished article

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

Books and other monographs

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

Chapter in book

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

No authror given

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

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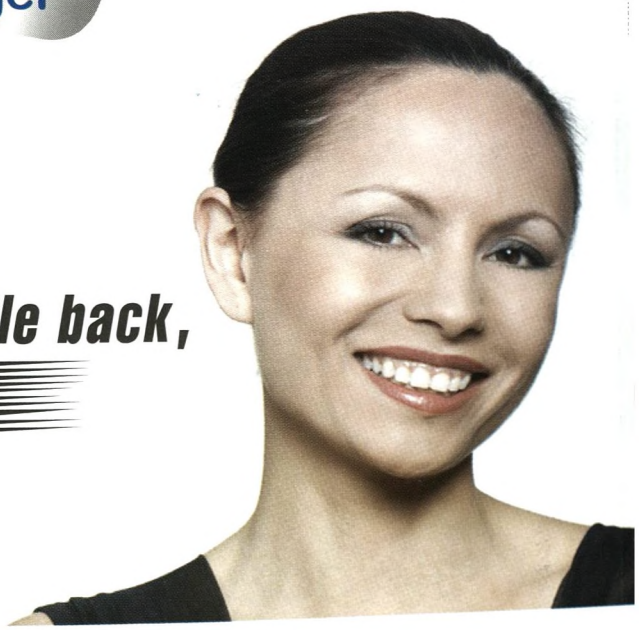

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1. Yankell SL, et al. J Clin Dent. 1993; 4(2): 26-30. 2. Amoroso MF, et al. J Clin Periodontol. 2002; 29: 615-621.
3. FDA U.S. Food & Drug Administration. Health Claim Notification for Fluoridated Water and Reduced Risk of Dental Caries. http://www.fda.gov/Food/LabelingNutrition/LabelClaims/FDAModernization/ucm038602.htm. Accessed April 2012.
4. ten Cate JM. Euro J Oral Sciences 1997; 105: St. 461-465. http://onlinelibrary.wiley.com/doi/10.1111/j.1600-0722.1997.tb00231.x/abstract. Accessed April 2012.

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