Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 8, Issue, 03, pp.27527-27531, March, 2016

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

APEXUM: THE MAGIC WAND IN ENDODONTICS

***Dr. Prem Prakash, Dr. Dakshita Joy Sinha, Dr. Shashi Prabha Tyagi and Dr. Udai Pratap Singh**

Department of Conservative Dentistry and Endodontics, Kothiwal Dental College & Research Centre, Moradabad (U.P.)-244001

ARTICLE INFO

Article History:
Received 14th December, 2015
Received in revised form
20th January, 2016
Accepted 29th February, 2016
Published online 16th March, 2016

Key words:
Apexum,
Periapical Surgery,
Root canal Treatment.

ABSTRACT

Apical periodontitis is an inflammatory process around the apex of a tooth root. It is primarily a sequel to microbial infection of the pulp space of teeth and is a remarkably widespread problem. The clinical management of apical periodontitis involves infection control by root canal treatment and often requires up to 12-24 months. The new Apexum procedure is based on advancing the debridement one step further by minimally invasive removal of the inflamed periapical tissues through root canal access, thereby enhancing the healing kinetics of periapical lesions. The Apexum procedure uses two sequential rotary devices designed to extend beyond the apex and to mince periapical tissues on rotation in a low-speed handpiece, followed by washing out the minced tissue. The PubMed database search reavealed that the reference list for Apexum featured four articles and for periapical surgery featured 2820 articles. A forward search was undertaken on selected articles, author names and contemporary endodontic texts.

Citation: Dr. Prem Prakash, Dr. Dakshita Joy Sinha, Dr. Shashi Prabha Tyagi and Dr. Udai Pratap Singh, 2016. "Apexum: The magic wand in endodontics", *International Journal of Current Research,* 8, (03), 27527-27531.

INTRODUCTION

Apical periodontitis is primarily a sequel to microbial infection of the pulp space of teeth and is a widespread problem. The clinical management of apical periodontitis involves infection control by root canal treatment. When microrganisms persist at the time of root filling there is higher risk that the treatment will fail and continue to maintain periapical inflammation (David Figdor, 2002).Most but not all periapical lesions will heal in response to properly performed endodontic treatment. It often requires up to 24 months and even then it is achieved in only 72-87% of the cases (David Figdor, 2002; Metzger *et al*., 2009). In an extensive study Orstavik concluded that (David Figdor, 2002) at 6 months only 50% of the cases that eventually healed showed clear signs of healing (advance and complete healing) and (Metzger *et al*., 2009) at 12 months 88% of the lesions that eventually healed showed clear signs of healing. So he concluded a case should ideally be followed for 12 months before the tooth may be considered a safe abutment (Metzger *et al*., 2009).Performing apical surgery (apicoectomy) on every case with a periapical lesion most likely enhances healing kinetics. Nevertheless, it is hardly justified because surgery has repercussions on the well being of the patient; swelling, pain and discomfort are among the expected side effects. The prolonged healing process of many periapical lesions has been attributed to the activated macrophages in the lesion that may maintain their state of activation long after the initial cause of their activation has been eliminated by root canal treatment. The production of bone-resorbing cytokinesby these cells may persist for many months after the completion of the root canal treatment, thus preventing resolution of the periapical bone defects. Apexum; a new approach in this field represents a shift from the current endodontic paradigm. Since it does not limit the endodontic intervention to the removal of the cause (bacteria), instead it enters the periapical lesion beyond the apical foramen to convert a chronic lesion into new granulation tissue and promotes tissue repair with less postoperative discomfort, pain or swelling. Therefore the purpose of this review is to increase awareness regarding this new innovative procedure in the dental fraternity.

Historical background

The nitinol used in apexum device is a super elastic nickel – titanium alloy first developed for the US Navy. It was first used in 2008 (David Shamah, 2008).The first reported application of apexum procedure in endodontic was carried out by Metzger *et al* for enhancing healing kinetics of periapical lesions in dogs in January 2009 (Metzger *et al*., 2009).Soon after Metzger *et*

****Corresponding author: Dr. Prem Prakash,***
Dept. of Conservative Dentistry and Endodontics, Kothiwal Dental College & Research Centre, Moradabad (U.P.)-244001.

al. conducted a clinical trial to investigate the healing kinetics of periapical lesions enhanced by apexum procedure in February 2009 (Metzger *et al*., 2009).

Microbiology of apical Periodontitis

Apical periodontitis is essentially an inflammatory disease of microbial etiology primarily caused by infection of the root canal system. Microorganism colonizing the root canal system enter in contact with the periradicular tissues via apical/lateral foramens or root perforations. As a consequence of the encounter between microbes and host defenses, inflammatory changes take place in the periradicular tissues and give rise to the development of apical periodontitis (Bhaskar, 1972).The endodontic microbiota is clearly different in the coronal, middle and apical parts of the root canal. Anaerobic bacteria accounted for more than 90% of the isolates in apical periodontitis (Kenneth, 2011)

Various treatment modalities available for treating apical Periodontitis

Conservative root canal treatment without adjunctive therapy

Bhaskar suggested that instrumentation should be carried 1 mm beyond the apical foramen when a periapical lesion was evident on a radiograph. This may cause transitory inflammation and ulceration of the epithelial lining resulting in resolution of the cyst (Bhaskar, 1972). Healing of large cysts like well-defined radiolucencies following conservative root canal treatment has been reported. Although the cystic fluid contains cholesterol crystals, weekly debridement and drying of the canals over a period of two to three weeks, followed by obturation did led to a complete resolution of lesions by 12to 15 months (Al-Kandari *et al*., 1994).

Decompression Technique

The decompression technique involves placement of adrain into the lesion, regular irrigation, periodic length adjustment and maintenance of the drain, for various periods of time (Loushine *et al*., 1991). The drain could either be 'I' shaped pieces of rubber dam, (Sommer, 1964) polyethylene tube along with a stent, (Patterson, 1964) hollow tubes, (Colquhoun, 1969; Freedland, 1970)a polyvinyl tubing, (Loushine *et al*., 1991) suction catheter (Rees, 1997)or a radiopaque latex tubing (Martin, 2007). Daily irrigation of the lesion could be carried out by the patient through the lumen of the drain using 0.12% chlorhexidine (Martin, 2007; Brondum and Jensen, 1991). The advantages of this technique are; it is a simple procedure, minimizes the risk of damaging adjacent vital structures, and is easily tolerated by the patient (Loushine *et al*., 1991). However, several disadvantages have also been noted; patient compliance is very essential, inflammation of the alveolar mucosa, persistence of the surgical defect at site, development of an acute or chronic infection, displacement or submergence of the drainage tube (Çalişkan *et al*., 1997; Mejia *et al*., 2004).

Active nonsurgical decompression technique

This technique uses the Endo-eze vacuum system (Ultradent, Salt Lake, Utah) to create a negative pressure, which results in the decompression of large periapical lesions. Unlike the decompression technique, this technique is minimally invasive as the entire procedure is done through the root canal and causes less discomfort for the patient (Hoen *et al*., 1990).

Aspiration and irrigation technique

Hoen *et al,* suggested aspiration of the cystic fluid from the periapical lesion using a buccal palatal approach. In this technique, an 18-gauge needle attached to a 20 ml syringeis used to penetrate the buccal mucosa and aspirate the cystic fluid. A second syringe filled with saline is thenused to rinse the bony lesion. The new needle is inserted through the buccal wound and passed out through the palatal tissue creating a pathway for the escape of the irrigant (Hoen *et al*., 1990). The disadvantage of this technique is the creation of buccal and palatal wounds that may cause discomfort to the patient (Fernandes and Ataide, 2010).

Aspiration through the root canal technique

In this technique, aspiration of the cystic fluid is done through the root canal by passing the aspirating needle through the apical foramen. This technique eliminates the creation of buccal and palatal wounds. Severely curved canals may limit the use of this technique as the canal anatomy prevents the aspirating needle from reaching the apical foramen. This technique may also not be favorable innarrow-rooted teeth. However, it is advisable not to use this technique where adjacent tissue spaces or sinus cavities are involved and in infected periapical lesions (Hoen *et al*., 1990;Fernandes and Ataide, 2010).

Method using calcium hydroxide

Souza *et al.,* suggested that the action of calcium hydroxide beyondthe apex may be four-fold: (a) anti-inflammatory,(b) neutralization of acid products, (c) activation of the alkaline phosphatase, and (d) antibacterial action (Ghose *et al*., 1987). Asuccess rate of 80.8 (Çalişkan and Şen, 1996) and 73.8% (Çalişkan, 2004) has been reported with calcium hydroxide, when used for endodontic treatment of teeth with periapical lesions. Some studies have reported that long-term exposure of root dentin to intracanal calcium hydroxide leads to a decrease in the fracture resistance of teeth (Doyon *et al*., 2005; Andreasen *et al*., 2006). A method using calcium hydroxide, demineralized freeze-driedbone allograft, and Mineral Trioxide Aggregate (MTA) has been described by Chhabra *et al*., for apexification of an immature tooth associated with a large periapical lesion.

Lesion sterilization and repair therapy

The Cariology Research Unit of the Niigata University School of Dentistry has developed this concept of using a triple antibiotic paste of ciprofloxacin, metronidazole and minocycline, for disinfection of oral infectious lesions, including dentinal, pulpal and periradicular lesions (Sato *et al*.,?; Hoshino and Takushige, 1998).A disadvantage of the triple antibiotic paste is tooth discoloration induced by minocycline.

Apexum procedure

The new Apexum procedure represents ashift from the current endodontic paradigm. Foremost, it does not limit the endodontic intervention only to removing the cause (bacteria)and then allowing the host to heal at its own pace,and furthermore, the device enters the periapicallesion far beyond the apical foramen.

Apexum devices

The Apexum kit consists of two devices, the Apexum NiTi Ablator and Apexum PGA Ablator, designed to be used sequentially. Both instruments are for single use. The Apexum NiTi Ablator consists of a specially preshaped Nitinolwire. One end is bent and is designed to enter the periapical tissues through the root canal and apical foramen, whereas the other end has alatch-type connector to allow its operation by a low-speed contra-anglehandpiece. The bent part is initially concealed in a straight super elastic Nitinol tube that serves as a sheath allowing its introduction up to the apical foramen. When pushed, the wire emerges from its sheath and through the apical foramen and resumes its preshaped form. The special retrograde design of the bent part allows it torotate in the periapical soft tissues at 200 to 250 rpm and coarsely grind them while being deflected from the surrounding bone. The Nitinol sheath is used first to allow the introduction of the prebent Nitinol wire to the apical foramen and second to allow unobstructed rotation of the wire in the root canal without twisting of the wire (Metzger *et al*., 2009; Metzger *et al*., 2009). The second device is the Apexum PGA Ablator, built from a Nitinolshaft, equipped on one end with a latch-type connector to allow its operation by a low-speed contra-angle handpiece.PGA(poly glycolic acid) – synthetic absorbable suture material, is available in braided multifilament and monofilament, iolet or undyed. At the other end, a bio absorbable filament is attached, which is designed to enter the periapical bony crypt and rotate at 5,000 to 7,000 rpm for 30 seconds, turning the tissue that is initially minced with the NiTi Ablator into a thin suspension hat may be flushed through the root canal (Metzger *et al*., 2009; Metzger *et al*., 2009).

Apexum procedure

A #20 K-file is passed through the apical foramen and beyond the apex to verify patency. It is followed by a rotary #30 file that is passed 1 mm beyond the apical foramen, creating a passage with a 330µm diameter. The Apexum NiTi Ablator is then inserted, while encased in its sheath, to the working length as established at the cleaning and shaping stage. The sheath is stabilized to the occlusal surface of the tooth using glass-ionomer cement. The Nitinol filament is then pushed manually through the enlarged apical foramen and into the periapical tissues. The NiTi Ablator is then rotated in the periapical tissues for 30seconds at 200 to 250 rpm to initially mince the tissue.

The stabilizing glass-ionomer cement is then removed and the NiTi Ablator withdrawn from the root canal with its sheath to examine it for any mechanical damage or missing parts. The root canal is then rinsed with sterile saline, and the Apexum PGA Ablator is manually inserted through the root canal and into the periapical tissues. It is then connected to a low-speed contra-angle hand piece and rotated for 30 second sat 5,000 to 7,000 rpm to turn the minced tissues into a thin suspension. Next, it is withdrawn from the root and examined for any mechanical damage or missing parts (Metzger *et al*., 2009; Metzger *et al*., 2009).The tissue suspension is now washed out with sterile saline solution. The cross-sectional area between the enlarged apical foramen and the outer surface of the needle is 3.4 times larger than that of the needle's lumen. This facilitated an unobstructed backflow and prevented pressure buildup in the periapical crypt. The Apexum procedure is usually performed under local anesthesia, provided in a manner similar to that used for tooth extraction or surgical intervention. With some experience, it generally takes an additional 7 to 10minutes compared with a conventional root canal treatment (Metzger *et al*., 2009; Metzger *et al*., 2009)(Fig 1).

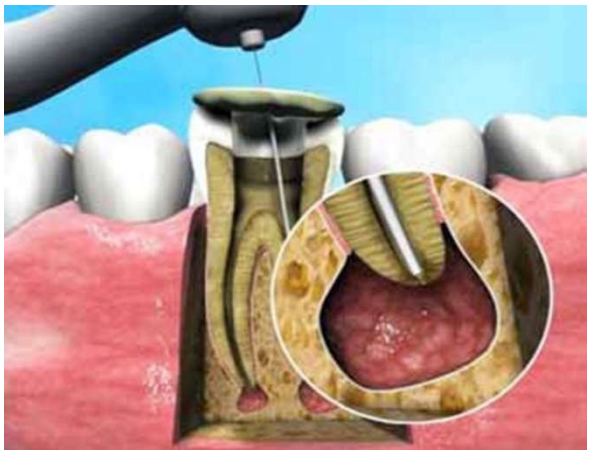

Figure 1. Apexum procedure

Advantages

- Removal and debulking of periapical lesions without using scalpels, periosteal elevators or sutures
- Minimal invasive technique.
- Removes chronically inflamed periapical lesions through root canal access.
- Overcome the drawbacks of the conventional surgical procedure.
- Enhanced healing kinetics of periapical lesions (Metzger *et al*., 2009; Metzger *et al*., 2009).
- No events of severe postoperative pain or swelling (Metzger *et al*., 2009).
- Gentle on patient wellbeing.
- The procedure does not require surgical skills.
- 9.The Apexumprocedure is more likely to eliminate bacterial biofilm or at least mechanically disturb them to the extent of disrupting the host-bacteria equilibrium in favour of the host.

Disadvantages

Some authors think that the insertion of the endodontic instruments far beyond the apical foramen should be avoided by all means because it is likely to cause a flare-up. Widening

of the apical foramen to form a passage of 330µm diameter may lead to softened guttapercha extruding beyond the apex. Management of procedural errors (instrument separation) is a matter of concern (Metzger *et al*., 2009; Raisingani, 2011).

Indications

Chronic apical periodontitis

As a supplement to conventional RCT for teeth with periapical lesion (David Shamah, 2008).Treat infection while the root canal is in progress (Raisingani, 2011).

Contraindications

There is no absolute contraindication in using this procedure.

Clinical applications in Endodontics

With conventional procedures treating the periapical pathology is difficult and time taking. Surgical approach on the other hand may cause lot of trauma and sometimes it may be very difficult to convince the patient for surgery. Performing apical surgery on every case with a periapical lesioncan hardly be justified because surgery has repercussions on the well-being of the patient; swelling, pain and discomfort are among the expected side effects (Kvist, 2000). Furthermore, many anatomic locations preclude apical surgery either because of inaccessibility or risk to adjacent structures. In an extensive study, Ørstavik concluded that (Ørstavik, 1996) at 6 months, only 50% of the cases that eventually healed showed clear signs of healing (advanced and complete healing), and (Friedman, 2002) at 12 months, 88% of the lesions that eventually healed showed clear signs of healing (Friedman, 2002). This may imply that a case should ideally be followed for 12 monthsbefore the tooth may be considered a safe abutment. A clinical trial conducted concluded that the Apexum procedure resulted in no events of severe postoperative pain or postoperative swelling and in only a few events of postoperative discomfort or mild pain(9%).While conventional root canal treatment resulted in some discomfort or pain for 31% of the cases. It is also important to note that when a conventional, open-flap, apical surgery is performed, many of the patients do experience pain, swelling orboth and usually need analgesics in the days after surgery.

Concern over the controversial issue of widening of the apical foramen to form a passage of 330µm diameter has also been expressed. But there is ample demonstration in the anatomic literature that the apical part of root canals is wider than 350 to 400 µm in normal adult teeth and larger when resorbing apical periodontitis has developed. The apical constriction and the apical foramen itself may harbor bacterial biofilms that may be left untouched by the limited apical preparations. The foramen may become even wider when apical resorption takes place, as is often encountered in roots with apical periodontitis. Many of the current nickel-titanium rotary file systems limit the instrumentation at this area to diameters of 250 to 300 µm while avoiding any preparation in the constriction of the apical foramen itself. The device enters the periapical lesion far beyond the apical foramen, a process expected by many operators to result in a flare-up or severe symptoms (Friedman, 2002; Siqueira, 2005). A controversy is associated with this concept too as many authors feel that the insertion of an endodontic instrument far beyond the apical foramen should be avoided by all means because it is likely to cause a"flare-up," a painful exacerbation of the periapical inflammatory process but it should be noted that the Apexum procedure is substantially different from simple over instrumentation during root canal treatment. The last traumatizes the tissue and may also introduce bacterial antigens into a tissue containing immunoglobulin's directed against these antigens and that is primed to respond to them. Till date two studies related to the field of endodontic have been carried out. In one the authors concluded that there was enhancement of healing kinetics of periapical lesions in dogs when the Apexum procedure was carried out (Metzger *et al*., 2009).In the second study the Apexum procedure was applied, as a supplementary step, during conventional root canal treatment in 48teeth with periapical lesions. Safety and efficacy were clinically and radiographically evaluated. The result of the study showed that no adverse events occurred in the Apexum-treated group and the healing kinetics was significantly enhanced (Metzger *et al*., 2009).

Uses in other fields of dentistry in Implantology

When a broken-down tooth with a largeperiapical lesion has to be extracted and replaced by an implant, the implantologist is presented with a dilemma: if there is no bone defect around the apex, an immediate implant could be successfully placed. However, when there is a large periapical lesion and no bone to engage the implant's apical part, augmentation will be required which becomes either a long and expensive story or a compromised procedure. Suchbone augmentation is provided within a relatively short time by the Apexum procedure (Raisingani, 2011).

In oral surgery

In case of management of cysts, the decompression and aspiration irrigation techniques can be used when there is drainage of cystic fluid from the canals. These techniques act by decreasing the hydrostatic pressure within the periapical lesions. When there is no drainage of fluid from the canals, calcium hydroxide, triple antibiotic paste and apexum procedure can prove beneficial (Bansal *et al*., 2013).

Future prospective and Conclusion

Many times it is difficult to treat the periapical pathology with conventional procedures and takes a lot of time to heal. At the same time surgical approach may cause lot of undesirable trauma and sometimes may be very difficult to convince the patient for surgery. So in such cases, Apexum procedure which causes minimal trauma to the tissues seems to be a promising alternative. Although there are certain controversies regarding the use of this procedure as discussed earlier but all have been answered by some authors supporting this procedure. The only concern which may pose a problem in using this procedure is the management of procedural errors (instrument separation etc), so this issue needs to be addressed for future use. Therefore; although Apexum procedure seems to be promising alternative to periapical surgeries more long term in vivo studies are warranted in this aspect.

REFERENCES

Al-Kandari, A.M., Al-Quoud, O.A. and Gnanasekhar, J.D. 1994. Healing of large periapical lesions following nonsurgical endodontic therapy: Case reports. *Quintessence Int*., 25:115-9.

Andreasen, J.O., Munksgaard, E.C. and Bakland, L.K. 2006. Comparisonof fracture resistance in root canals of immature sheep teethafter filling with calcium hydroxide or MTA. *Dent Traumatol,* 22:154-6.

Bansal, R., Khursheed, I. and Bansal, T. 2013. Endodontic Management of a Periapical Cyst- A Review. *J Adv Med Dent Scie.,* 1(1);7-16.

Baumgartner, J.C., Rosenberg, P.A., Hoen, M.M. and Lin, L.M. 2008. Treatment of endodontic infections,cysts, and flare-ups. In: Ingle, JI Bakland, LK Baumgartner, eds. JC Ingle's Endodontics. 6th ed. Hamilton, Canada: BC Decker, 690 –712

Bhaskar, S.N. 1972. Nonsurgical resolution of radicular cysts. *Oral Surg Oral Med Oral Pathol.,* 34:458-68.

Brondum, N. and Jensen, V.J. 1991. Recurrence of keratocysts and decompression treatment. *Oral Surg Oral Med Oral Pathol,* 72:265-9.

Çalişkan, M.K. 2004. Prognosis of large cyst-like periapical lesions following nonsurgical root canal treatment: A clinical review. *Int Endod J*., 37:408-16.

Çalişkan, M.K. and Şen, B.H. 1996. Endodontic treatment of teeth with apical periodontitis using calcium hydroxide: A long-term study. Endod Dent Traumatol12:215-21

Çalişkan, M.K. and Türkün, M. 1997. Periapical repair and apical closure of a pulpless tooth using calcium hydroxide. *Oral Surg Oral Med Oral Pathol,* 84:683-7.

Colquhoun, N.K. 1969. Treatment of large periapical lesions by an indwelling tube. *J. Br. Endod Soc.,* 3:14-6.

David Figdor. 2002. Apical periodontitis: A very prevalent problem. *Oral Surg Oral Med Oral Pathol*, 94:651-2.

David Shamah. 2008. Apexum goes to the root of the problem. Israel.http://israel21c.org

Doyon, G.E., Dumsha, T. and von Fraunhofer, J.A. 2005. Fracture resistance of human root dentin exposed to intracanal calcium hydroxide. *J Endod.,* 31:895-7.

Fernandes, M. and Ataide, I. Non-surgical management of a large periapical lesion using a simple aspiration technique: A case report. *Int. Endod J*., 2010;43:536-42

Freedland, J.B. 1970. Conservative reduction of large periapical lesions. *Oral Surg Oral Med Oral Pathol*., 29:455-64.

Friedman, S. 2002. Prognosis of initial endodontic treatment. Endod Topics., 2:59–88.

Ghose, L.J., Baghdady, V.S. and Hikmat, B.Y. 1987. Apexification of immature apices of pulpless permanent anterior teeth with calcium hydroxide. *J Endod.,* 13: 285-90.

Hoen, M.M., LaBounty, G.L. and Strittmatter, E.J. 1990. Conservative treatment of persistent periradicular lesions using aspiration and irrigation. *J. Endod.,* 16:1.82-6.

Hoshino, E. and Takushige, T. 1998. LSTR 3Mix-MP method-better and efficientclinical procedures of lesion sterilization and tissue repair (LSTR)therapy. *Dent Rev.,* 666:57-106

Kenneth M. Hargreaves,Stephen Cohen. Microbiology and treatment of endodontic infections.In:JOSÉ F. SIQUEIRA, JR and ISABELA N. RÔÇAS, editors. Cohen's pathway of the pulp 10th ed.pg 560-600.

Kvist, T. and Reit, C. 2000. Postoperative discomfort associated with surgical and nonsurgical endodontic retreatment. Dental Traumatol,16:71– 4.

Loushine, R.J., Weller, R.N., Bellizzi, R. and Kulild, J.C. 1991. A 2-day decompression: A case report of a maxillary first molar. *J Endod.,* 17:85-7.

Martin, S.A. 2007. Conventional endodontic therapy of upper central incisor combined with cyst decompression: A case report. *J Endod.,* 33:753-7.

Mejia, J.L., Donado, J.E. and Basrani, B. 2004. Active non-surgical decompression of large periapical lesions- 3 case reports. *J Can Dent Assoc*, 70:691-4.

Metzger, Z., Huber, R., Slavesscu, D., Dragomirescu, D., Tobis, I. and Better, H. 2009. Healing kinetics of periapical lesions enhanced by the Apexum procedure:A clinical trial. *J Endod*., 35:153-9.

Metzger, Z., Huber, R., Tobis, I. and Better, H. 2009. Enhancement of healing kinetics of periapical lesions in dogs by the Apexum procedure. *J Endod.,* 35 :40-5.

Ørstavik, D. 1996. Time course and risk analysis of the development and healing of chronic apical periodontitis in man. *Int Endod J.,* 29:150 –5.

Patterson, S.S. 1964. Endodontic therapy: Use of a polyethylene tube and stint for drainage. *J Am Dent Assoc.,* 69:710-4.

Raisingani, D. 2011. Apexum: A minimum invasive procedure. *Int J Clin Ped Dent.,* 4(3): 224-7.

Rees, J.S. 1997. Conservative management of a large maxillary cyst. *Int Endod J.,* 30:64-7.

Sato, I., Kurihara- Ando, N., Kota, K., Iwaku, M. and Hoshino, E. 1996. Sterilizationof infected root- canal dentine by topical application of a mixture ofciprofloxacin, metronidazole and minocycline in situ. *Int Endod J.,* 29:118-24.

Siqueira, J. 2005. Reaction of periradicular tissues to root canal treatment: benefits and drawbacks. *Endod Topics*;10:123–47.

Sommer, R.F., Ostrander, F.D. and Crowley, M.C. 1964. Clinical Endodontics. 2nd, ed. Philadelphia, USA: W.B. Saunders and Co..

****