

ABSTRACT

This invention relates to an innovation of designing and using dental implant with apical pores for drug delivery to the brain. Nano-drug is deposited beneath the nasal respiratory mucosa or the maxillary sinus mucosa using a novel, cost effective, dental implant with a porous apical end. The nano-drug distributes into systemic circulation and to the brain from the delivery site using the neural, lymphatic and the vascular route. The device provides long term, pain free, non-invasive, continuous and controlled drug delivery to the brain.

Dated this 30/07/2015 day of July 2015

Signature



30/07/15

Name of the signatory U. R. ANOOP

I/We claim

1. A dental implant which has micro-pores at the apical end with a rounded tip and with an internal involute spline connection made of titanium alloy or any other biocompatible material. The implant is tapered or parallel walled with a rounded tip. The outer surface of the implant may be smooth or with threads. Pores may be present only at the apical part. These pores connect the internal surface of the implant with the surrounding nasal respiratory mucosa or the maxillary sinus lining mucosa. The dental implant has either internal cervical threads or internal retentive studs with smooth cervical walls at the cervical end for placement of a cervical ring. An internal involute spline connection is present in the internal surface of the implant below the level of the cervical ring and extends apically. The implant has a screw free, disposable abutment made of titanium alloy or any other biocompatible material. The abutment has an external involute spline connection that adapts with the internal involute spline connection of the implant. The abutment has an internal central vent that open as pores on the external surface at the apical end. The pores may be micro-pores or nano-pores. The abutment is retained with a cervical ring made of titanium alloy or any other biocompatible material.
2. The dental implant abutment as claimed in claim 1 wherein the abutment is tapered occlusally with the broader part at the cervical end. The abutment is screw free and is retained with a cervical ring. The abutment has an internal central vent passing through the intra-oral part and the intra-implant part. There are multiple pores on the external surface of the abutment at the apical end that connect to the internal central vent. The pores may be micro-pores or nano-pores. The opening of the central vent at the top of the intra-oral part of the abutment is closed by a disposable cap. The abutment may be angulated above the barrier ring. The opening of the central internal vent of the abutment may be on the side instead of the top of the abutment to provide access for drug delivery in demanding clinical situations.
3. The dental implant abutment as claimed in claim 1 wherein the abutment can act as a reservoir for drugs. The apical pores on the abutment may be nanopores and match the size of the drug molecule being delivered. This may help movement of drugs into circulation from within the abutment reservoir without any need for an osmotic chamber. The design is used when small quantities of drug delivery are needed in a continuous and controlled manner.
4. The dental implant abutment as claimed in claim 1 wherein the abutment can act as a reservoir for drugs. It may work as an osmotic drug delivery device or as a micro electro mechanical system of controlled drug delivery using electronic chips.

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(C.R. Anoop)

5. Specially designed infusion kits with a disposable abutment and cervical ring are used to deliver the drugs into the porous implant. The infusion kits may be manually controlled, osmotically driven or based on micro electro mechanical system of drug delivery.

6. The dental implant abutment as claimed in claim 1 wherein the abutment can have an access hole on the side. A crown with a side opening can be placed on top of the abutment. The access hole on the side of the abutment can be accessed through the side opening in the crown. The opening on the side of the crown is closed with a screw.

7. The crown as claimed in claim 6 wherein the crown with a side opening can be placed on a root canal treated tooth that is not obturated. The pulp cavity in the tooth can be accessed through the side opening in the crown whenever drug delivery is required into the tooth.

8. A mini plate with a central micro-porous or nano-porous drug reservoir dial with external or internal threads which is closed with a cap made of a resilient, biocompatible material that self seals whenever penetrated by a needle are used for drug delivery. The porous drug reservoir dial base is placed in close proximity to the respiratory mucosa. The drug is delivered into the drug reservoir dial using a needle that penetrates the cap and deposits the drug into the drug reservoir dial space. The drug reaches the respiratory mucosa through the pores in the drug reservoir dial base. The mini plate is secured to the bone by screws at the limbs.

9. A dental implant with micro-pores at the apical end for placement under nasal respiratory mucosa and maxillary sinus lining mucosa for non-invasive drug delivery to the brain by bypassing the blood brain barrier. The implant may be cylindrical or tapered, with an internal involute spline connection within the implant that connects with the external involute splines of the abutment. The implant may have internal cervical threads or internal retentive studs with a smooth cervical region for the attachment of a cervical ring. The screw free abutment may be parallel walled or tapered and has a central vent and apical pores with external involute splines. The cervical ring may have external threads or slots for retention. Specially designed infusion kit for drug delivery into the implant may be manually controlled, osmotically driven or micro electromechanically controlled. A crown with a side access hole for drug delivery for use on implants and root canal treated teeth. A mini plate with a central micro-porous or nano-porous drug reservoir dial with external or internal threads which is closed with a cap made of a resilient, biocompatible material that self seals whenever penetrated by a needle for drug delivery substantially as herein described and illustrated in the figures of the accompanying drawings.

Dated this 30/07/2015 day of JULY 2015

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No. of Sheets **7**

Application no.

Sheet no. **1**

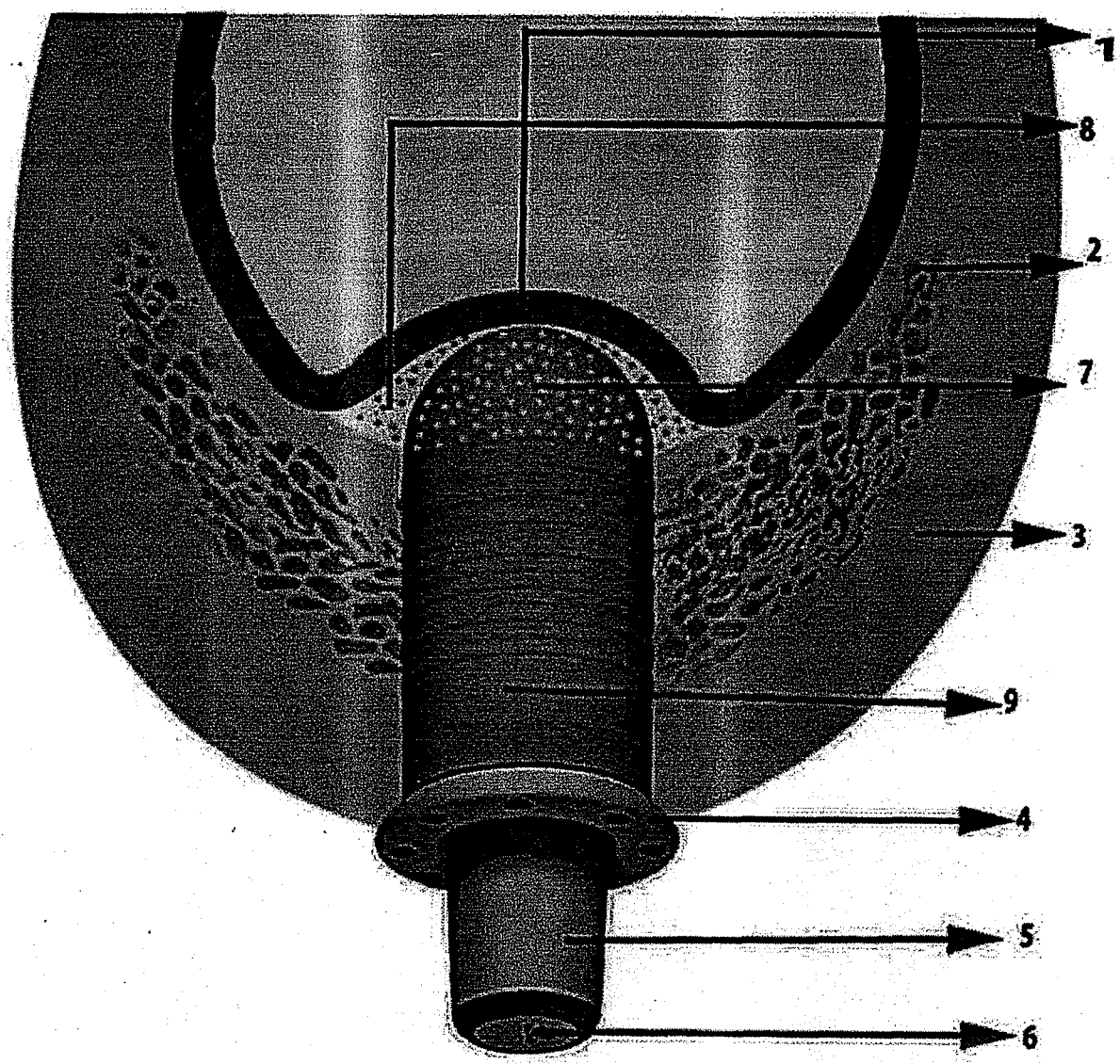


FIGURE -1

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Application No :

No of sheets: **7**
Sheet No: **2**

Fig A

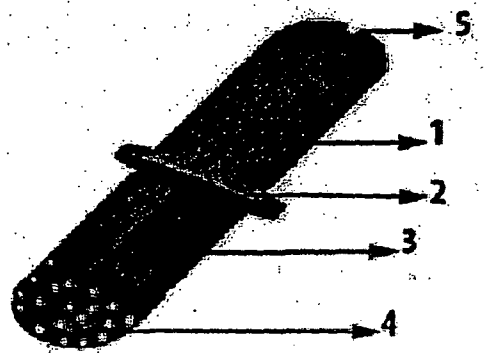


Fig B

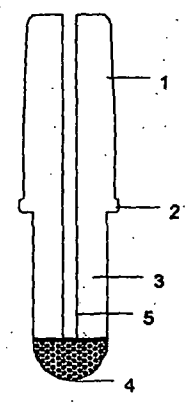


Fig c

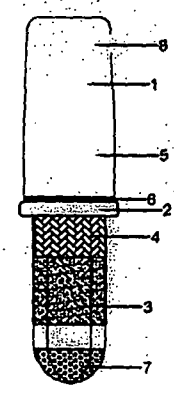


Fig D

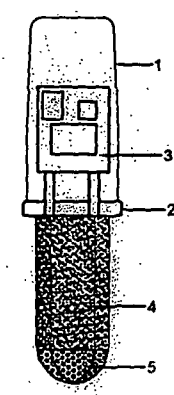


Fig E

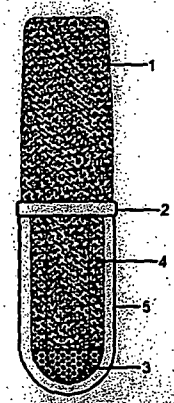


Fig -2

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Sheet No : 3

Fig A

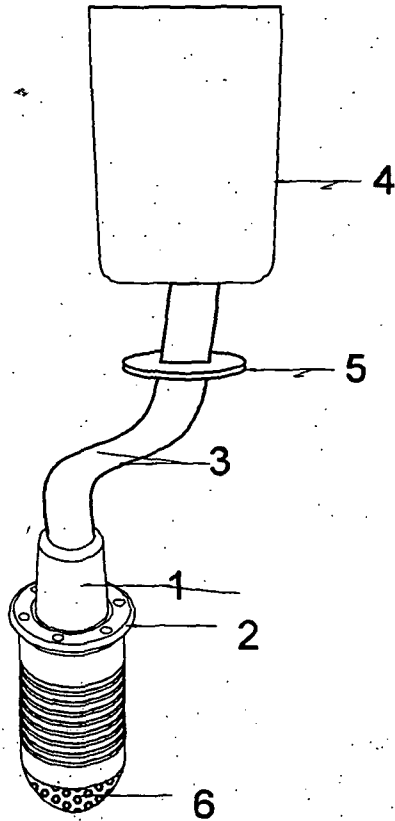


Fig B

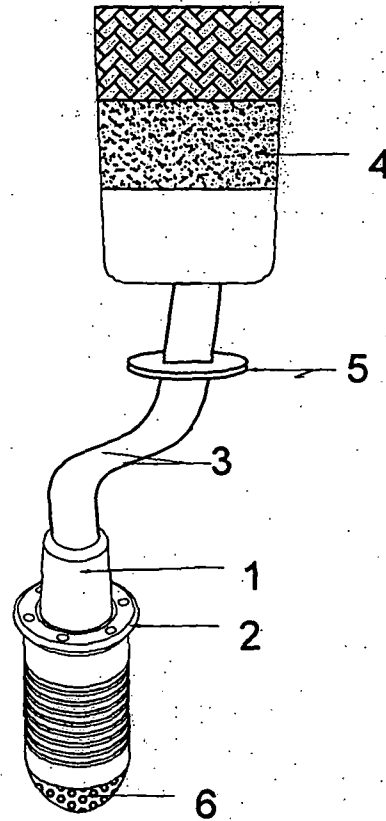


Fig c

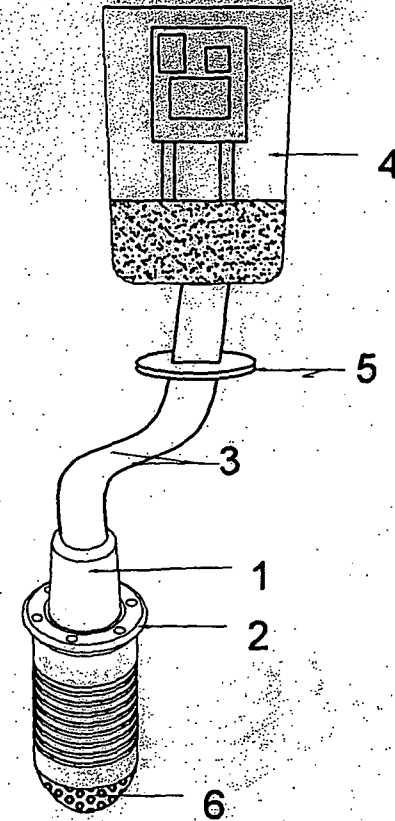


Fig -3


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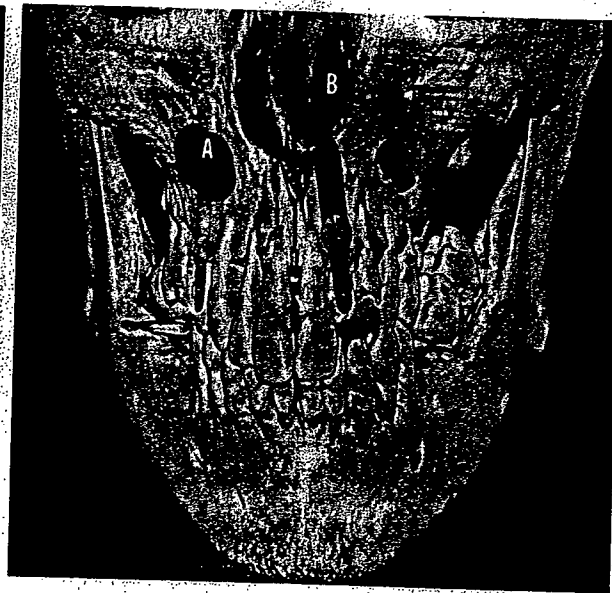
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A



B



C

FIGURE -4

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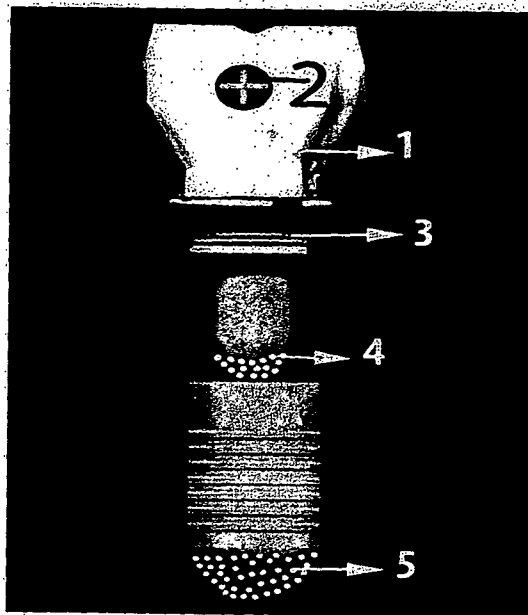
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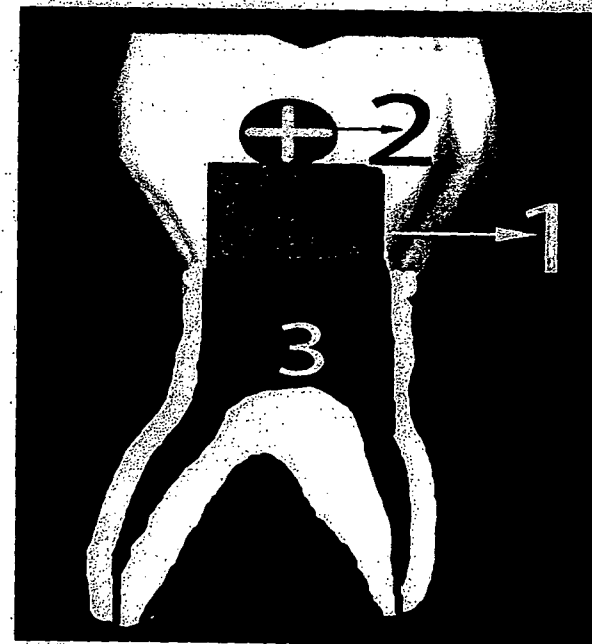
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A



B

FIGURE -5

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Sheet no. **6**

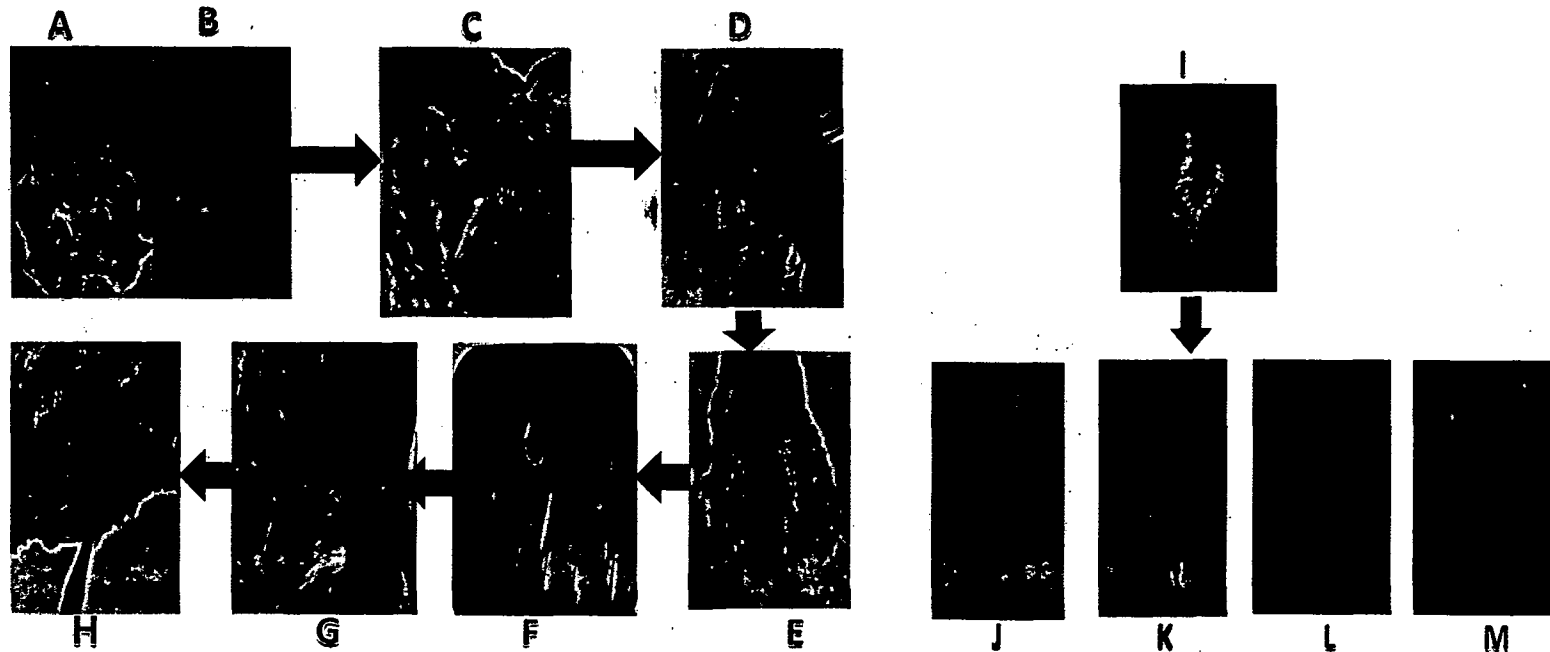


FIGURE -6

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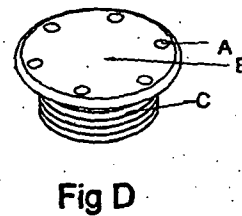
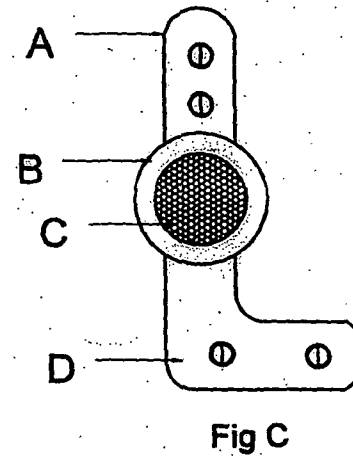
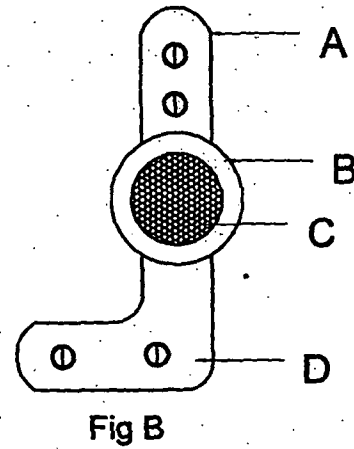
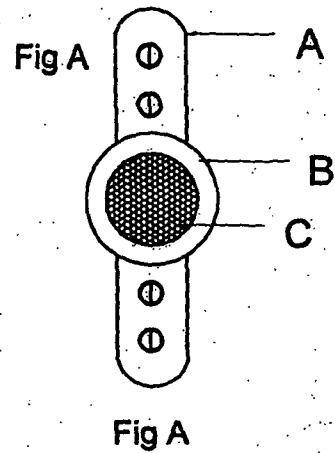


Fig -7

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COMPLETE SPECIFICATION

DENTAL IMPLANT FOR CONTINUOUS, LONGTERM, PAIN-FREE, NON-INVASIVE DRUG DELIVERY TO BRAIN BY BYPASSING THE BLOOD BRAIN BARRIER.

This invention relates to an innovation of designing and using dental implant as a drug delivery system for continuous, long term, pain-free, non-invasive drug delivery to brain by bypassing the blood brain barrier. The dental implant has a micro-porous apical end. It also has a disposable screw free abutment with an internal central vent and external pores at the apex. The abutment is retained by a cervical ring. The intra-oral part of the abutment is connected to an external drug reservoir for controlled drug delivery.

Dental implants are made of titanium and are used generally to replace missing teeth. But an innovative dental implant with a porous apical end that can be connected to a drug reservoir and placed at the proper anatomical surgical site in the maxilla can also be used to deliver drugs into the brain.

Drug delivery to the brain is restricted because of the blood brain barrier. Recent studies have shown that the nasal inhalation route can deliver the drugs directly to the brain. But this route is not reliable because of the anatomical limitations and delivery of inadequate therapeutic quantity of drugs to the brain by the available nasal drug delivery devices. Moreover medically compromised patients cannot perform the complicated inhalation maneuvers required to deliver drugs to the proper anatomical location in the nose using the existing nasal drug delivery devices.

Drug delivery to the brain from the nose has been predominantly found to be by the olfactory neural route especially from the olfactory region, bypassing first pass metabolism by the liver. Recently trigeminal nerve route also have been reported to deliver the drugs to the brain. Trigeminal nerve supplies the nasal respiratory mucosa and the maxillary sinuses and relays at the nuclei in the brainstem. Cerebrospinal fluid has been found to drain through nasal lymphatics. The nasal lymphatic channels are also free of valves and can hence be used for drug delivery. Blood vessels may also transfer the drugs to the brain from the nasal and maxillary sinus region. The veins from the maxillary sinus and the nasal region drain into the pterygoid venous plexus and drugs can be transferred by counter current mechanism at the cavernous sinus and enter the cerebral circulation at higher concentration without causing systemic toxicity. Hence Trigeminal nerve, nasal and maxillary sinus lymphatics and the vascular route in the nasal and maxillary sinus region can be used for drug delivery to the brain.

Hence, we are putting forward this new concept and design for patent:

A. Design and use of dental implants with a micro-porous apical end made of titanium or any other biocompatible material as a device for drug delivery to the brain.

B. Designing a new disposable abutment design with an internal central vent and external apical pores that can deliver the drugs into the porous implant.

C. A disposable cervical ring which is placed around the intra-oral projection of the abutment and screwed or friction fit to the inner surface of the implant.

D. A covering cap for closing the implant opening when the implant is not being used for drug delivery.

E. Specially designed drug delivery reservoirs and infusion kit for delivering medications to the porous implant through the abutment.

F. A dental crown with a side opening and a screw for closing which is used for drug delivery into the porous dental implant or into the pulp cavity of a root canal treated tooth.

G. A mini plate with a central micro-porous or nanoporous drug reservoir dial with internal or external threads which is closed with a cap made of a resilient, biocompatible material that self seals whenever penetrated by a needle.

One form of the invention comprises of a dental implant made of titanium alloy or any other biocompatible material with external threads. The implant has micro pores at the apical part of the implant body. The pores connect the internal surface of the implant with the nasal respiratory mucosa or the maxillary sinus lining mucosa. The implant has an internal involute spline connection within the implant body. The implant has internal threads at the cervical end. The disposable abutment with a micro-porous apical end is screw free, made of bio-compatible material and consists of an intra-oral or outer projection and an inner or intra-implant projection with a barrier ring between the two projections. The external surface of the intra-implant projection of the abutment has an external involute spline connection. The abutment also has a central vent which is connected to external apical pores for drug delivery. The abutment fits into the dental implant. The tip of the abutment is smooth and porous and is in contact and in alignment with the pores at the apex of the implant. A cervical ring with outer threads is slid from the top of the abutment and threaded into the threads in the inner cervical part of the implant. The inner aspect of the cervical ring adapts closely and tightly to the outer surface of the abutment to form a tight junction without any micro-leakage. The drug reservoir is connected to the intraoral part of the abutment.

In one form of the invention the disposable abutment may be angulated above the level of the cervical ring.

In one form of the invention the entry hole for the central vent on the abutment may be on the side.

In one form the external pores of the abutment can be modified as nano-pores equal to the size of the drug molecule and the abutment may act as a drug reservoir for controlled drug delivery.

In one form of the invention, the cervical ring is of variable heights depending on the soft tissue requirements and is closely adapted to the abutment on tightening.

In another form of the invention, specially designed drug reservoirs are used to place medications into the porous implant.

In another form of the invention, wherein the implant is placed in the alveolar ridge, the dental crown placed on the implant has a side opening. The opening may be in the buccal side or lingual side so that the side hole on the abutment can be assessed for drug delivery.

In another form of invention, the side opening on the side of the dental crown is closed with a screw when not used for drug delivery.

In another form of invention, the implant opening is closed with a covering screw when not used for drug delivery.

In another form of invention, a mini plate with a central micro-porous or nano-porous drug reservoir dial with external or internal threads which is closed with a cap made of a resilient, biocompatible material that self seals whenever penetrated by a needle are used for drug delivery. The porous drug reservoir dial is placed in close proximity to the respiratory mucosa. The drug is delivered into the drug reservoir dial using a needle that penetrates the cap and deposits the drug into the drug reservoir dial. The drug reaches the respiratory mucosa through the pores in the drug reservoir dial base. The mini plate is secured to the bone by screws.

To assist with understanding the invention, reference will now be made to the accompanying drawings, which show one example of the invention.

BRIEF DESCRIPTION OF THE DRAWING:

Fig.1 shows a dental implant which is micro-porous, at the apical end. It has a cervical ring for retention at the cervical end and a screw free disposable abutment with an internal central vent and apical micro-pores, according to this invention. The implant is placed beneath the nasal respiratory mucosa or maxillary sinus lining mucosa for drug delivery. The intra-oral part of the abutment can be connected to an external reservoir for drug delivery.

Fig.2 shows the abutment with the central internal vent and external apical micro-pores. The intra implant part has apical nanopores when the abutment is used as a drug reservoir.

Fig.3 shows the reservoir with the disposable abutment and retention ring used for delivering the medications into the porous implant.

Fig.4 shows the placement procedure for the implant and the drug delivery access routes to the brain.

Fig.5 shows the crown with the side opening and the screw for closing the opening .It can be used with the abutment or with a root canal treated tooth.

Fig.6 shows the proof of concept done on a freshly cut goat head. The drug is delivered under the respiratory mucosa from the hard palate in the experimental model. The light microscope histology images of unstained sections of goat brainstem show uptake of sodium fluroscein in the brain tissue.

Fig 7 shows a mini plate with a central micro-porous or nanoporous drug reservoir dial with internal or external threads which is closed with a cap made of a resilient, biocompatible material that self seals whenever penetrated by a needle. The limbs of the mini plate can be of various shapes. The limbs can be straight or L shaped.

Detailed description of the preferred embodiments:

Referring to FIG. 1, Fig: 1 refers to the isometric view of the dental implant placed beneath the nasal respiratory mucosa or the maxillary sinus lining mucosa.1 refers to the respiratory mucosal lining.2 refers to the surrounding alveolar bone.3 refers to the overlying oral mucosa.4 refers to the cervical ring.5 refers to the abutment .6 refers to the external opening of the central internal vent on the abutment.7 refers to the apical micro-pores on the implant.8 refers to the drugs deposited beneath the respiratory mucosa.9 refers to the external threads on the implant.

Referring to FIG. 2, Fig: A refers to the isometric view of the abutment with a central internal vent and external apical micro-pores. 1 refers to the outer or intra-oral projection of the abutment.2 refers to the barrier ring which fits into the implant body below the level of the cervical threads.3 refers to the involute external splines on the inner or intra-implant projection of the abutment for proper orientation of the pores.4 refers to the rounded apical end of the abutment which has pores.5 refers to the opening of the internal central vent. **Fig: B** refers to the longitudinal sectional view of the abutment with a central vent and apical pores. 1 refers to the outer or intra-oral projection of the abutment.2 refers to the barrier ring which fits into the implant body below the level of the cervical threads.3 refers to the involute external splines on the intra-implant projection of the abutment for proper orientation of the pores.4 refers to the rounded apical end of the abutment which has pores.5 refers to the internal central vent. 6 refers to the external opening of the central internal vent. **Fig: C** refers to the abutment when used as a reservoir for drugs on the principle of osmosis. 1 refers to the outer or intra-oral projection of the abutment.2 refers to the barrier ring which fits into the implant body below the level of the cervical threads.3 refers to the drug compartment. 4 refers to the osmotic push compartment. 5 refers to the water compartment. 6 refers to the semi-permeable rate controlling membrane.7 refers to the rounded apical end of the abutment which has pores. 8 refers to the side opening of the central internal vent at the intra-oral part of the abutment. **Fig: D** refers to the abutment when used as a reservoir for drugs on the principle of micro electro-mechanical drug delivery mechanism. 1 refers to the outer or intra-oral projection of the abutment.2 refers to the barrier

ring which fits into the implant body below the level of the cervical threads.3 refers to the micro electro mechanical compartment.4 refers to the drug compartment. 5 refers to the rounded apical end of the abutment which has pores. Fig: E refers to the nanoporous abutment when used as a reservoir for drugs. 1 refers to the outer or intra-oral projection of the abutment.2 refers to the barrier ring which fits into the implant body below the level of the cervical threads.3 refers to the rounded apical end of the abutment which has nanopores that equals the size of the drug molecule. This allows continuous flow of the drug at a controlled rate without any need for an osmotic agent.4 refers to the drug reservoir.5 refers to the packaging sleeve that holds the drug within the reservoir.

Referring to FIG. 3, Fig: A refers to reservoir with the disposable abutment and retention ring used for delivering the medications into the micro-porous implant. 1 refers to the disposable abutment with apical pores. The coronal end is connected to the reservoir tubing.2 refers to the cervical ring that is threaded or slide fit at the cervical end of the implant. It retains the abutment within the implant.3 refers to the tubing of the reservoir. The length and diameter of the tubing is designed to provide a continuous flow for small quantity of drugs.4 refers to the drug reservoir. 5 refers to the flow control. 6 refers to the porous implant. **Fig: B** refers to reservoir with the disposable abutment and retention ring used for delivering the medications into the porous implant using the principle of osmosis. 1 refers to the disposable abutment with apical pores. The coronal end is connected to the reservoir tubing.2 refers to the cervical ring that is threaded or slide fit at the cervical end of the implant. It retains the abutment within the implant.3 refers to the tubing of the reservoir. The length and diameter of the tubing is designed to provide a continuous flow for small quantity of drugs.4 refers to the drug reservoir with the drug and osmotic component. 5 refers to the flow control. 6 refers to the porous implant. **Fig: C** refers to reservoir with the disposable abutment and retention ring used for delivering the medications into the porous implant using the principle of Micro electromechanical drug delivery. 1 refers to the disposable abutment with apical pores. The coronal end is connected to the reservoir tubing.2 refers to the cervical ring that is threaded or slide fit at the cervical end of the implant. It retains the abutment within the implant.3 refers to the tubing of the reservoir. The length and diameter of the tubing is designed to provide a continuous flow for small quantity of drugs.4 refers to the drug reservoir with the drug and the micro electromechanical component. 5 refers to the flow control. 6 refers to the porous implant.

Referring to FIG. 4, Fig: A shows the surgical placement of the implant. A shows the implant with apical micro-pores placed into the osteotomy site in contact with the respiratory mucosa. The abutment with apical micro-pores is then placed into the implant. **B** shows the placement of the cervical ring. **C** shows the implant ready for attachment to the drug reservoir. **Fig B** shows the various anatomical sites for the drug delivery access routes to the brain from the facial aspect. **A** refers to the site below the maxillary sinus lining mucosa. **B** refers to the site below the nasal mucosa. **C** refers to the site below the maxillary sinus lining mucosa on the zygomatic process of the maxillary bone. **Fig C** shows the placement of the implants from the occlusal

aspect. **A** shows the placement into the zygomatic process of the maxillary bone beneath the maxillary sinus mucosa. **B** shows the placement into the posterior hard palate beneath the maxillary sinus mucosa. **C** shows the placement into the anterior hard palate beneath the nasal mucosa. **D** shows the placement into the alveolar bone beneath the nasal mucosa. **E** shows the placement into the alveolar bone beneath the maxillary sinus mucosa.

Referring to FIG: 5, Fig: **A** shows the crown with the side opening and the screw for closing the opening on the abutment. 1 refers to the crown. 2 refers to the side opening with the removable screw on the crown. 3 refers to the cervical ring. 4 refers to the abutment with apical pores. 5 refers to the implant with apical pores. **Fig: B** shows the crown with the side opening and the screw for closing the opening on the tooth. 1 refers to the crown. 2 refers to the side opening with the removable screw on the crown. 3 refers to the pulp cavity in the sectioned root canal treated tooth that is not obturated. The pulp cavity can be accessed through the side opening after placement of the crown whenever drug delivery into the tooth is required.

Referring to FIG: 6, **A** shows the palatal aspect of the goat head. **B** shows the coronal aspect of the goat head with the skull intact. **C** shows the palatal mucosa elevated exposing the hard palate. **D** shows the osteotomy site being prepared without tearing the underlying mucosa. **E** shows the porous implant in place. **F** shows an intra oral X ray showing the implant tip in contact with the palatal sinus mucosa. **G** shows the sodium fluorescein dye being delivered from an external reservoir. **H** shows the stained lateral aspect and floor of nasal mucosa with the implant after longitudinal sectioning. **I** shows the brain that was dissected after the dye delivery. **J** and **K** show histopathology sections of the brain showing orange - green uptake of dye in unstained brain stem tissue under a light microscope with incandescent light. **L** and **M** show histopathology sections of the brain showing a fluorescent green colour of the dye in unstained brain stem tissue under a light microscope with LED light.

Referring to FIG: 7, Fig **A** shows a mini plate with a central micro-porous or nanoporous drug reservoir dial and straight limbs. **A** refers to the straight limb with screw holes. **B** refers to the central micro-porous or nanoporous drug reservoir dial with internal or external threads. A cap is threaded onto the threads **C** refers to the micro-porous or nanoporous base of the drug reservoir dial. The drug is deposited into the dial. **Fig B** shows a mini plate with a central micro-porous or nanoporous drug reservoir dial and a left L shaped limb. **A** refers to the straight limb with screw holes. **B** refers to the central micro-porous or nanoporous drug reservoir dial with internal or external threads. A cap is threaded onto the threads **C** refers to the micro-porous or nanoporous base of the drug reservoir dial. The drug is deposited into the dial. **D** refers to the left L shaped limb with screw holes.. **Fig C** shows a mini plate with a central micro-porous or nanoporous drug reservoir dial and a right L shaped limb. **A** refers to the straight limb with screw holes. **B** refers to the central micro-porous or nanoporous drug reservoir dial with internal or external threads. A cap is threaded onto the threads **C** refers to the micro-porous or nanoporous base of the drug reservoir dial. The drug is deposited into the dial. **D** refers to the right L shaped limb with screw holes. **Fig D** shows the cap made of a resilient, biocompatible material that self seals

whenever penetrated by a needle. A refers to the holes used for holding the cap while threading it onto the reservoir dial. B refers to the self sealing part of the cap into which needles can be inserted. C refers to the threads on the cap. the threads can be external or internal.

MECHANISM OF ACTION:

The main objective of this invention is to use the new dental implant as a drug delivery system for continuous, long term, pain-free, non-invasive drug delivery to brain by bypassing the blood brain barrier.

Because of the blood brain barrier, drug delivery to the brain is restricted. The techniques available for brain drug delivery today are invasive or damage the blood brain barrier.

Recent studies have shown that the nasal inhalation route can deliver the drugs directly to the brain. But this route is not reliable because of the anatomical limitations and delivery of inadequate therapeutic quantity of drugs to the brain by the existing nasal drug delivery devices. Moreover medically compromised patients cannot perform the complicated inhalation maneuvers required to deliver drugs to the proper anatomical site in the nose using the existing nasal drug delivery devices. Drug also gets cleared fast by muco-ciliary action when applied on the nasal mucosa. Drug delivery to the brain by the nasal inhalation route is predominantly found to be by the olfactory neural route especially from the olfactory region by bypassing first pass metabolism by the liver.

Recently trigeminal nerve route also have been reported to deliver the drugs to the brain. Trigeminal nerve supplies the nasal respiratory mucosa and the maxillary sinuses and relays at the nuclei in the brainstem. Cerebrospinal fluid has been found to drain through nasal lymphatics. The nasal lymphatic channels are also free of valves. Blood vessels also transfer the drugs to the brain from the nasal and maxillary sinus region. The veins from the maxillary sinus and the nasal region may drain into the pterygoid venous plexus and drugs can be transferred by counter current mechanism at the cavernous sinus and enter the cerebral circulation in high concentration without causing systemic toxicity. Hence Trigeminal nerve, nasal and maxillary sinus lymphatics and the vascular route in the nasal and maxillary sinus region can be used for drug delivery to the brain if they can be surgically accessed from the underside of the respiratory mucosa. Thus vascular, neural and lymphatic routes from the respiratory mucosa can lead to systemic circulation and the brain.

Nano-drug is deposited beneath the nasal respiratory mucosa or the maxillary sinus lining mucosa using a novel, cost effective, micro-porous dental implant. The nano-drug distributes into systemic circulation and to the brain from the delivery site using the neural, lymphatic and the vascular route. The device provides long term, pain free, non-invasive, continuous and controlled drug delivery to the brain.

DIRECTION OF USE:

The implant osteotomy site is prepared with a drill of appropriate length and diameter. The osteotomy can be done on the maxillary alveolar process, hard palate or the zygomatic process of the maxilla without tearing the underlying respiratory mucosa. The osteotomy is stopped short by 1mm of the maxillary sinus lining mucosa or the nasal respiratory mucosa. The apical 1mm of bone is gently broken with a bone compression tool or with an elevator by gentle tapping. Care is taken not to tear the nasal mucosa or the maxillary sinus mucosa. The implant is gently threaded into the osteotomy site. The lining mucosa is further elevated by the smooth apical end of the implant. The porous apical part of the implant is thus in contact with the base of the lining mucosa. The implant can be placed at the bone level or the tissue level depending on the clinical requirements. A temporary cover screw in the form of a cervical ring of adequate diameter and height, with no central hole is placed. The dental implant is allowed to osseointegrate. After appropriate healing time, the cover screw is removed and the implant is ready for use. In routine situations a temporary abutment is placed and connected to the drug reservoir for controlled drug delivery. After the delivery, the abutment is removed and the cover screw is replaced.

In emergency situations, where drug delivery is the priority, the abutment can be pushed into a narrow osteotomy site temporarily for drug delivery.

In cases where the implant is placed on the alveolar ridge, a dental crown with a buccal or palatal access hole is used with an abutment that has a lateral vent opening. Drug is delivered into the porous implant via the side hole in the implant which in turn is accessed through the side opening in the crown. The access hole in the crown is closed with a screw when not used for drug delivery.

A root canal treated tooth can also be used for systemic drug delivery. After bio-mechanical preparation, the tooth is prepared for a crown without obturation. An access hole of a standard diameter is made using a round bur on the buccal or palatal aspect connecting the exterior with the pulp cavity. The crown is prepared with a side opening correlating with the buccal or lingual hole on the tooth. The tooth can then be accessed for drug delivery through the opening in the crown whenever needed. The hole in the crown can be closed with a screw when not in use.

In cases where mini plates with drug reservoir dials are used, a full thickness mucosal flap is elevated. Appropriate diameter of bone is removed with a bur or a piezo instrument, without damaging the overlying respiratory epithelium. The dial is placed into the osteotomy with its porous base in close proximity to the respiratory mucosa. The top of the dial consists of a threaded cap which is biocompatible and self seals when penetrated by a needle. The mini plate is fixed to the bone by mini screws. The flap is replaced over the reservoir and allowed to heal. Drug can be injected into the reservoir dial space using a needle from the overlying anaesthetized mucosa whenever needed.