

Risk Management when Operating in the Posterior Mandible

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Professor Branemark performed his landmark research placing titanium implants in the anterior mandible anterior to the mental foramen.¹ The quality of bone in this area was ideal, as it is one of the densest areas of bone in the human skeleton. Providing that the principles of surgery originally suggested by Branemark are followed, the most important being not to overheat the bone when preparing the osteotomy site,² osseointegration will occur.

In 1992, Gunne and colleagues³ published their paper on *Implants in Partially Edentulous Patients*. This important article compared bridges solely supported by implants with bridges supported by implants and natural teeth. This longitudinal study used mandibular bilateral free-end saddle cases with implants being placed in the posterior mandible. The study admitted that 39% of the implants placed caused some form of nerve damage.

In the posterior mandible there are many potential problems when contemplating implant placement. These include the anatomy of the region and the density of bone. All of these issues need to be addressed and a protocol formed that suggests techniques to reduce the risk of nerve damage and avoid pathological overload.

ANATOMY

The course of the inferior dental (ID) nerve is obviously the most im-

A risk management protocol for the placement of implants in the posterior mandible is a sensible precaution for reducing the risk of nerve damage and the risk of possible litigation. This paper identifies the need for careful treatment planning and the use of relevant tests (eg, the CT scan). A protocol is presented that advised the use of

certain procedures to reduce the risk of nerve damage. These procedures consider the incision, the type of anesthetic, x-rays as you proceed, the type of implant, and use of anti-inflammatories. (Implant Dent 2002;11:67-72)

Key Words: *inferior dental nerve, implants, diagnosis and treatment planning, CT Scan*

portant obstacle to safe surgery in this region; but it is also important to observe the curvature of the bone (especially on its lingual aspect) and to understand the course of the lingual nerve.

The ID nerve enters the mandible on its internal aspect just above the lingula. It then descends anteriorly, running above the lower border, usually in the middle of the body of the jawbone. As it proceeds anteriorly it also moves toward the buccal aspect of the mandible where it finally emerges through the mental foramen.

There is much variation between individual mandibles, from the actual course of the nerve⁴ to whether there is an anterior loop of this nerve before it exits through the mental foramen.⁵ It is, therefore, essential to diagnose and treatment plan accurately. Moreover, the treatment plan must be followed when operating in this region.

DIAGNOSIS AND TREATMENT PLANNING

A panoramic x-ray is usually the first test performed when investigating this area. Many of the modern machines will give an accurate 1.25% magnification for all regions.

The panoramic view is also valuable in that it will show the superior cortical border of the nerve (Fig. 1) better than a periapical x-ray. A periapical x-ray should also be taken as you can then accurately check the measurements using a long cone X-Ray System and an X-Ray Holder (Rinn Corporation, Elgin, IL).⁶ If there is a good height of bone above the ID canal, you will now need to know if the width of the ridge and the shape of the body of the mandible are favorable before you proceed. The width of bone can be measured using a ridge mapper first described by Wilson.⁷ The shape of the bone, particularly on its lingual aspect, can be observed using a tomogram program on a modern panoramic machine. This view is for estimation only as measurements are often inaccurate. Palpation of this area can reassure the operator that the lingual anatomy is favorable. Fig. 4 and Fig. 5, discussed later in this article, describe possible life-threatening problems if the surgeon fails to realize there is an unfavorable curvature of the mandible.

If these tests suggest a risk to operating safely, a CT scan is taken before continuing with the treatment planning. The later versions of Sim/

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Fig. 1. Panoramic x-ray showing the cortical superior border of the inferior dental nerve.

Plant software (Sim/Plant Columbia Scientific, Inc., Columbia, MD)⁸ that allow colored marking of the ID canal and the placement of implants simulated on computer give an ideal assessment of possible treatments. The CT scan allows for measurements to be accurate to the nearest millimeter, as well as conveying a 3-D image. It is also possible to color in the nerve so that the operator can see it in panoramic and cross-sectional view (Fig. 2). The operator can then plan the surgery accurately by actually simulating the placement of the implants (Fig. 3). The software will give a printout of the implants required, including bone density using the Hounsfield scale and full 3-D images. One must always discuss with the patient the possible risks of nerve damage and remember that the implant placed must be capable of bearing the considerable load placed on an implant in this area, especially because the quality of the bone may be poor.

The CT scan can be beneficial in revealing where the shape of the mandible changes on its lingual aspect (Fig. 4). If one places an implant in this region, the implant may look satisfactory on the panoramic x-ray, but the x-ray will show the implant encroaching the floor of the mouth (Fig. 5). The literature reports many cases of life-threatening hemorrhage in this region.^{9,10}

A possible solution to limited height of bone could be a nerve repositioning procedure¹¹ where the ID nerve is moved surgically to a more lateral position allowing for the placement of a longer and possibly

wider implant. This procedure bears the risk of nerve damage; and the patient must be fully aware of all possible consequences.

When diagnosing and treatment planning for implant placement in the posterior mandible, it is essential to assess the maximum comfortable jaw opening of the patient. If there were not sufficient vertical space for the handpiece and spade drill, it would not be possible to place the implant in the right position. The Straumann diagnostic T Plus (Institute Straumann, Waldenburg, Switzerland) (Fig. 6) is a very useful instrument to check adequate access. There is no point in proceeding if the patient is not able to open wide enough to allow drilling the osteotomy site at the right angulation. One might also consider using an implant system that has short spade drills and an implant that can be placed easily (eg, a cylinder, basket, or ridged or finned implant).

The clinician then needs to make a laboratory assessment using study models mounted on an adjustable articulator with a face-bow (Fig. 7). Teamwork with the technician is essential. This includes the use of a diagnostic wax-up or denture wax-up. The technician would then construct a surgical template that can be taken sterile to the surgical site, to guide the operator to the exact position and projection of each implant (Fig. 8). Surgical template and their design will depend on the specific situation. It should be remembered that the template should be designed to allow for the use of a rubber bite-block on the other side to secure the

opening of the jaw. A psychological assessment should also be made to decide if the patient is suitable for implant therapy.¹²

SURGICAL PROTOCOL

It is suggested that when making a decision to proceed with surgery, know when to say “no.” Providing the assessment suggests it is safe to proceed; it is possible to reduce the risk of error by using one or all of the following suggestions.

Incision

There is only one safe incision to make in this area, and that is the midcrestal incision. Cranin’s¹³ work shows it to be the incision with the greatest blood supply, and the Veterans Administration study¹⁴ shows this incision to be as successful as any of the palatal or sulcular incisions and far safer. Certainly it will reduce the chance of lingual nerve damage, long buccal nerve damage, or a major bleed.

There is one extra advantage for a midcrestal incision—the clinician can go immediately to a transmucosal implant. This may have been the planned result, but it should also be considered that the operator might decide to leave the implant above the crest of the ridge because of nerve sensation. An implant placed to the length calculated from all the special tests, including a CT scan, can be seen in Fig. 9. The implant has then been backed out 2 mm. A transmucosal implant would now be an ideal way to close the tissues around the exposed implant.¹⁵

Anesthesia

It would be useful to use infiltration anesthesia on tissues adjacent to the osteotomy site and not an inferior alveolar nerve block, providing the patient is not of a nervous disposition. This will allow one to incise tissues without causing pain; and as bone has no nerve sensors, it can also be drilled without causing pain. Obviously, the usual precautions are taken when drilling the osteotomy site (ie, incrementally increasing the diameter of the spade drills and using internal and external irrigation).¹⁶

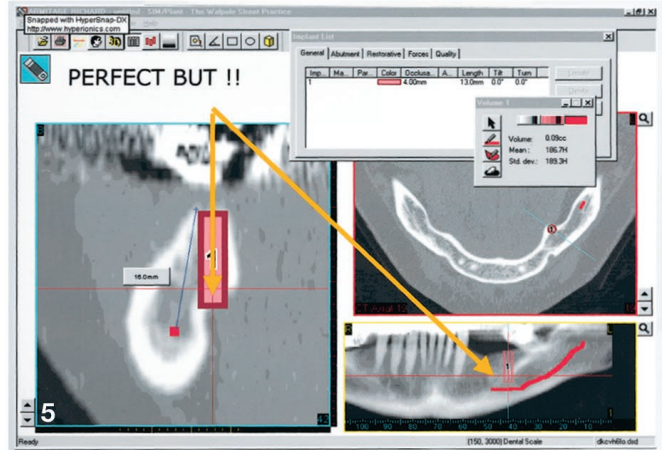
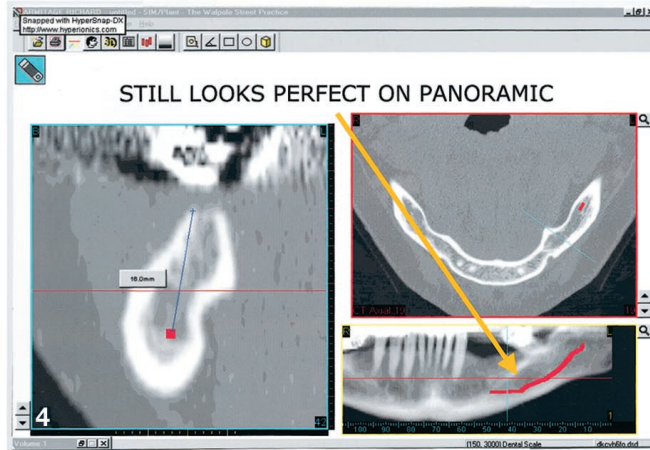
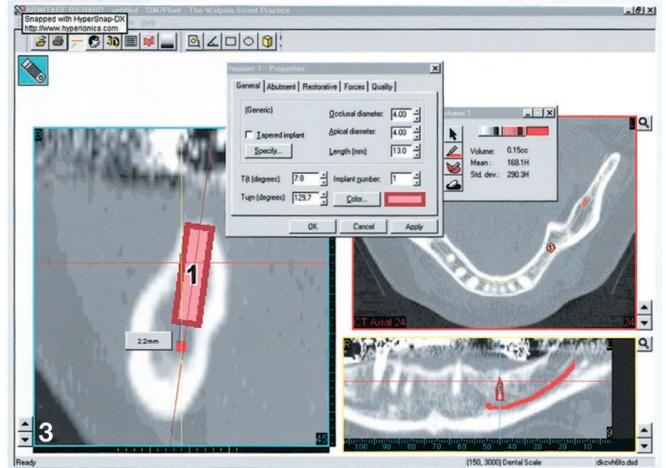
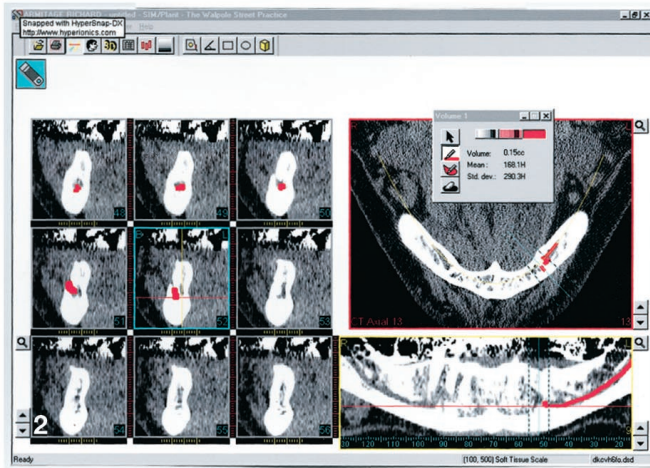


Fig. 2. CT scan showing the inferior dental nerve painted in red. See the nerve showing up on the cross sections and emerging from the mental foramen.
Fig. 3. With the nerve painted in, the software allows you to enlarge the cross section and drag the implant into the exact position you would like to place it. Obviously you need a 2-mm safety margin above the nerve. The panoramic picture shows the implant in place, and the chart allows adjustment of the size of all aspects of the implant.
Fig. 4. The position for implant placement looks perfect on the panoramic picture. However, note the shape on the lingual aspect of the enlarged cross section.
Fig. 5. The implant appears to be in an ideal position on the panoramic picture, but you can see the danger of placing an implant without understanding the lingual anatomy.

The patient has been informed of the reasoning behind this type of anesthesia and agrees to inform the operator if they feel any sensation or discomfort whatsoever. The patient can

usually give the operator a warning when the preparation of the osteotomy site is within 2 mm to 3 mm of the nerve.

measure the partially prepared site (Fig. 10). Most implant systems have metal measuring gages that can be left in place when taking the x-ray. An infrared mouse can be used that will allow the surgeon to make their own measurements. A sterile transparent sheet must cover the mouse. It will now be possible to proceed to the decided length with more confidence. If the bone is dense, then bone tapping must be undertaken.



Fig. 6. The Straumann diagnostic T Plus is a very useful instrument at the consultation stage when one can simply place it between the upper and lower jaws to check adequate access.

X-Ray as You Proceed

It is very useful to be able to exactly see the depth of the osteotomy site throughout the procedure. This can be achieved very simply by using a sterile plastic sheath (similar to those used over a surgical hand-piece) to cover the x-ray or sensor if using a digital x-ray. The surgeon can line up the sterile long-cone X-Ray holder and the running nurse can line up the x-ray unit. A digital system can be used to view and

Type of Implant Used

When drilling in the posterior mandible it is important to establish surgical access in the region. If access is limited, certain decisions need

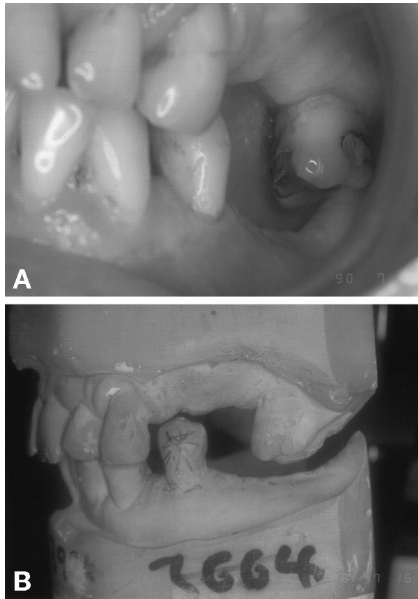


Fig. 7. Intraoral photo (7A) and study models (7B) mounted on an adjustable articulator with a face-bow, demonstrating an impossible restorative situation. In this case, the bone would have been ideal for implant placement, but impossible to restore.

to be made. There must be sufficient access to allow drilling of that particular site at the right angulation. It may be necessary to consider using shorter spade drills. It may be appropriate to use a cylinder implant, ridged implant, or basket implant (with threads half way down) to allow for placement without a hand-piece or ratchet system to screw in the threaded implant.

Use of Anti-Inflammatories

When drilling into dense bone there is bound to be some trauma. If the site is near the nerve, there may be some altered sensation because of swelling. As a precautionary mea-

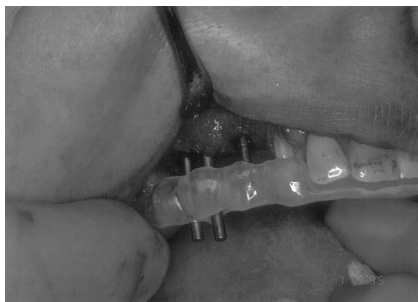


Fig. 8. A surgical template is an essential guide to accurate placement of implant.

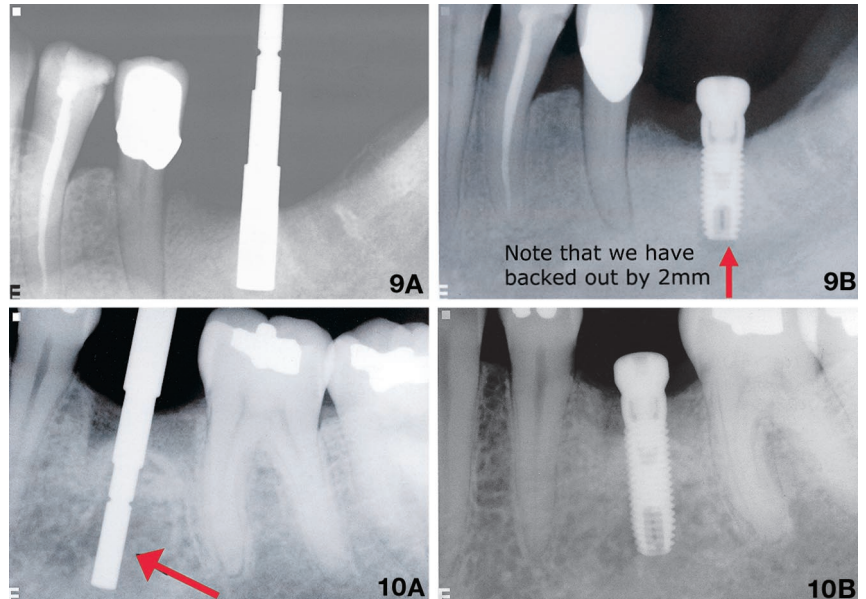


Fig. 9. Note we have backed out by 2 mm when placing the implant. The red arrow (9B) shows the outline of the osteotomy site. This situation illustrates the importance of a crestal incision and being able to make the implant transmucosal.

Fig. 10. The arrow (10A) points to the surgical paralleling instrument, which also acts as a measuring instrument when taking an x-ray as one proceeds (10B).

sure, it is wise to prescribe an anti-inflammatory drug to reduce this reaction. Dexamethasone is a useful one-dose drug (6.6 mg in 2 ml given iv or im 1 hour before the start of surgery). An alternative would be an oral anti-inflammatory (eg, ibuprofen) that would act as a painkiller as well.^{17,18}

SUMMARY

This article discusses when to recommend implant placement in the posterior mandible and when to say “no” to operating in this region. Appropriate treatment planning is the only way to gather the necessary information. A CT scan must be prescribed if there is any doubt as to where the nerve is and its precise distance to identifiable landmarks.

This article has discussed how the following suggestions will reduce the possibility of nerve damage, if it is decided to proceed with the preparation of an osteotomy site: A protocol where the type of incision, the placement of the anesthetic agent, and the use of an x-ray during the operation to check the depth of the osteotomy all contribute toward a safer surgical technique. It is suggested that the use of an anti-

inflammatory drug will also reduce the possible risk of nerve damage.

DISCLOSURE

The author claims to have no financial interest in any company or any of the products mentioned in this article.

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Abstract Translations [German, Spanish, Portuguese, Japanese]

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ZUSAMENFASSUNG: Die Erstellung eines Protokolls zur Eingrenzung des Behandlungsrisikos bei Implantierung im hinteren Unterkieferbereich dient im Vorfeld als probates Mittel zur Verhinderung des Auftretens von Nervenschädigungen und soll daraus möglicherweise resultierende Rechtsstreitigkeiten ausschließen. Es besteht die unabdingbare Notwendigkeit einer sorgfältigen Behandlungsplanung und entsprechenden Testdurchführung (z.B. Computer-Szintigramm) im Vorfeld, wie der vorliegende Bericht zeigt. Es wird der Vorschlag eines Protokolls unterbreitet, demzufolge bestimmte Vorgehensweisen einzuhalten sind, die dem Auftreten von Nervenschädigungen vorbeugen sollen. Dies schließt unter anderem die Methoden bei Inzision und Narkose während des Eingriffes ein. Außerdem werden Empfehlungen bezüglich der zu verwendenden Röntgenstrahlung, der Auswahl des geeigneten Implantats und des Einsatzes von entzündungshemmenden Stoffen gegeben.

SCHLÜSSELWÖRTER: tief gelegene Nervenstränge, Implantate, Diagnose- und Behandlungsplanung, Computer-Szintigramm

ABSTRACTO: Un protocolo de la administración del riesgo para la colocación de implantes en la mandíbula posterior es una precaución sensata para reducir el riesgo de daño a los nervios y el riesgo de litigación posible. Este trabajo identifica la necesidad de una planificación cuidadosa del tratamiento y el uso de análisis útiles, como por ejemplo, la tomografía computada. Se presenta un protocolo que sugiere el uso de ciertos procedimientos para reducir el riesgo de daño a los nervios. Los mismos incluyen: la incisión, el tipo de anestésico; radiografías a medida que progresa; tipo de implante y el uso de antiinflamatorios.

PALABRAS CLAVES: nervio dental inferior, implantes, diagnósticos y planificación del tratamiento, tomografía computada

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SINOPSE: um protocolo de gestão de risco para a colocação de implantes na mandíbula posterior representa uma precaução recomendável para reduzir os riscos de danos ao nervo e de possíveis problemas. Este estudo identifica a necessidade de planejamento meticuloso do tratamento e o uso de testes relevantes; por exemplo, a tomografia computadorizada. Apresenta-se um protocolo que sugere o uso de certos procedimentos para reduzir o risco de danos ao nervo, entre os quais incluem-se: a incisão; o tipo de anestésico; exames de raios X durante o procedimento; tipo de implante; além do uso de anti-inflamatórios.

PALAVRAS-CHAVES: nervo dentário inferior, implantes, planejamento de tratamento e diagnósticos, tomografia computadorizada.

下顎後部手術におけるリスク管理

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概要: 下顎後部インプラント設置のためのリスク管理計画案は、神経損傷と医療訴訟のリスクを減らすために有効な予防策である。この論文は、慎重な治療計画とそれに関連したCTスキャンなどのテストの重要性を指摘する。リスク管理計画案は、神経損傷リスクを軽減させるために、特定の処置の使用を薦める。この処置選択枝には、切開、麻酔薬の種類、治療過程でのX線使用、インプラントの種類、抗炎症薬の使用が含まれる。

キーワード: 下位歯槽神経、インプラント、診断と治療計画、CTスキャン

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