ADG Treatment Guide - Consent to undertaking Crown, Inlay, Onlay and Bridge (CIOB) procedures

What is a Crown, Inlay, Onlay Bridge (CIOB) Procedure and why is it performed?

A CIOB procedure is one where a tooth (known as an 'abutment') is prepared to receive a prosthetically constructed tooth that covers the abutment in whole or in part. The CIOB may be made from a metal such as Nickel/Chrome, Cobalt/Chrome, Palladium, Gold, or a mixture of metals. Alternatively, the CIOB can be made from a glass ceramic, or a densely sintered ceramic such as alumina or zirconia. The different materials have different properties, benefits and limitations and your dentist will explain and recommend any proposed materials for your specific case. For some CIOB procedures the dentist needs to remove the current restoration and upgrade the core. This will be discussed below.

You may require a CIOB procedure for several reasons:

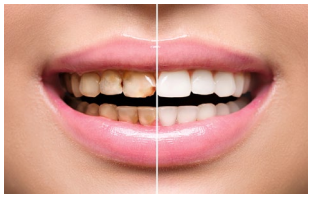
- Large filling/restoration with weakened cusps
- A large filling/restoration which need a rigid veneer material to hold it together and stop the weaker filling core material from breaking
- To preserve the tooth space and contact points (marginal ridges) to preserve the integrity of the bite due to an over-contoured filling material
- After root canal therapy to seal the tooth and stop weakened and undermined cusps from breaking and to provide a seal to prevent ingress of bacteria
- Fractured, decayed or defective existing crown
- History or suspect grinding which may cause/has caused other teeth to fracture
- A tooth which will become an abutment (support) for a bridge or a partial denture or a full denture('overdenture')
- A tooth which will become a support
- Poor aesthetics such that replacement of current crown and bridge work would be desirable

Large Weakened Cusps

Fractured Crown

Crown to seal a root canal, post and core

Worn, chipped teeth due to grinding



Poor dental appearance

Support to bridge a gap

Justification for a CIOB, evaluation of residual tooth structure and preparatory work

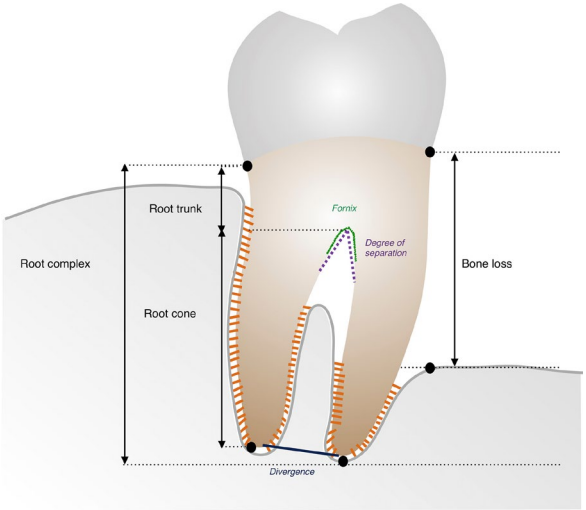
Before embarking on a CIOB procedure gum disease and decay need to be under control. Any bleeding during the impression procedure will result in errors in fabrication. It is a common misunderstanding that a crown 'strengthens' a tooth. A crown derives success from the presence of adequate residual tooth structure.

The dentist also needs to assess the vitality of the tooth (whether the nerve is alive or dead). The dentist may use a cold ice stick, or undertake a gentle cavity preparation (without anaesthetic), or use an electric pulp tester to determine if a tooth still has a positive 'vitality' nerve response:

Vitality tester being used to ensure that the tooth is alive

If the tooth is dead the dentist needs to consider the need to complete root canal therapy before embarking on a new crown. If the tooth already has a root filling, the dentist needs to evaluate the integrity of that root filling to ensure that it is not leaking bacteria. If the root canal is deemed inadequate, then consideration needs to be made to repeating that root filling.

The dentist needs to therefore evaluate how much existing tooth structure there is to bond on to, or to cover with a CIOB veneer material. There needs to be sufficient length and width of tooth structure to retain a crown, inlay or onlay restoration. The root 'divergence' and 'root cone', and the amount of associated bone loss will determine whether it is worth crowning the tooth or whether the tooth needs to be removed:



Parameters used to determine the prognosis of a tooth prior to crowning

The dentist may sometimes need to remove current restorative materials from within the internal structure of the root to evaluate the amount of residual core of dentine. The dentist will also evaluate the length, and shape of the roots and the neck of the tooth between the roots and the core known as the trunk. Subject to there being adequate integral tooth structure, a CIOB restoration can be justified.

From time to time, there is an adequate 'trunk' however due to deep decay or a deep filling the edges of the tooth are situated under the gum. Under these circumstances a 'crown-lengthening' procedure can be undertaken to surface and reveal more tooth structure which can then be used in the CIOB procedure. This procedure is often performed across multiple teeth however can be performed on a single tooth:

The gum is lifted and the bone is gently removed with a drill or laser to 'reveal' more tooth structure which can be used as a 'ferrule' to retain the new crown.

The preparation margins for your new crown, inlay, only or bridge abutment must exist either above the gum line or no more than 1 mm below the gum line otherwise it will be impossible to capture the detail of this gum line in impression procedures.

Finally, the dentist needs to assess the bite, how teeth guide across each other, and assess joint function by assessing mobility, range of opening and clicking to establish baseline jaw function. A new crown which does not conform to the bite and does not have the correctly engineered bite parameters has the potential to alter the bite and cause remodelling of the joint which could cause pain, discomfort, clicking and locking.

When assessing the bite, the dentist may identify excessive tooth wear due to a sub-optimal bite. When this is identified the dentist may recommend additional procedures prior to the CIOB procedure to optimise the bite and create a more harmonious guidance between the teeth.

Single Unit or Multiple Units

When multiple prosthetic units are being constructed there is sometimes a need for additional planning particularly if these teeth need to be constructed symmetrically as part of a smile redesign procedure. In a smile redesign procedure the dentist will take multiple baseline photos to help with smile evaluation, and may even take a small video with a high quality phone to undertake a 'dynamic smile visualisation'. The dentist will take impressions (sometimes digital impressions) and provide instructions to the technician to fabricate a diagnostic model. This can be done as an optimised 'tooth wax-up' which can be made in real wax or using a clever digital waxing technique.

Do you need the tooth core replaced, or a post placed as part of a new core?

When you are about to embark on a new crown such as a rigid full veneer material to hold a fragile tooth together, your dentist will need to consider if you need the core of the tooth (which is usually hollow) to be replaced. The best core materials are made of composite resin materials, which sometimes have fibre-mesh inclusions to improve the structural properties of the material. From time to time, your dentist will recommend a bespoke core that is cast in a metal. This is when there is little peripheral tooth structure to cement a crown to. The post will then need to carefully fit into the root space which has received a root canal procedure. He/she will then undertake a very specialised impression to capture the root space detail, and a core with a cast post will be constructed. This will need to be fitted just before a new crown is constructed:

Cast metal post cemented to a compromised root to provide a better core to enable fitting of a crown.

On front teeth it is common to place a cast metal post into the root as part of a crown procedure. This is usually recommended when a crown would otherwise not be possible, and the root would otherwise need to be extracted. One of the longer-term sequelae of a 'post'-crown is that the abutment will fracture. It is at this juncture when a tooth and associated crown will need to be replaced in favour of an alternative restorative procedure.

A dentist may decide and recommend placing a crown with an integral core. These restorations are called inlays and onlays, the subtle difference being that an onlay covers the cusps of the tooth to prevent these flexing (and subsequently breaking) in a heavily restored tooth.

The choice of material and Tooth Preparation

(Left) Zirconia Crown, (Middle) Gold Crown, (Right) Porcelain fused to metal eg. Palladium, Nickel, Cobalt-Chrome

The various materials namely metal, glass ceramic or densely sintered ceramic require different thicknesses of material to ensure strength. There are many considerations on choice of materials, the main considerations being durability and aesthetics.

- For crowns that are right at the back of the mouth where aesthetic demands are low, gold-based cast crowns offer the most successful solution for longevity. Gold crowns are not aesthetic and will show even at the back of the mouth when you smile broadly. Other metal-based crowns such as Nickel Chrome, or Cobalt Chrome are slightly cheaper than gold-based crowns but are very hard materials and may be abrasive against antagonist teeth unless these have similar restorations.

- In the patient who grinds and bruxes their teeth, glass ceramic restorations are not the most suitable. The best restorations are metal based restorations, ideally gold, which will maintain durability even in relatively thin section above 0.9 mm

- For crowns at the front of the mouth in the young patient, a glass ceramic crown offers the best aesthetics, but the lowest fracture toughness. A product known as ‘e-max’ is a glass-ceramic material and has been optimised to create the balance between strength and aesthetics. Glass-ceramic restorations are not suitable in the bruxist/grinder patient, particularly when the tooth that is being treated is a ‘guiding’ tooth.

- ‘E-max’ glass-ceramic can be bonded to and will bond to tooth structure and is therefore an excellent material to fabricate as an ‘inlay’ instead of a large filling when this is too large. The properties of glass-ceramic materials are insufficient to use as an ‘onlay’ to hold flexing cusps together.

- When an inlay is required but where the material needs to hold flexing cusps together (such as in a bruxist), then gold is the most suitable restoration.

- Where strength and aesthetics are required, a densely sintered ceramic such as zirconia has the potential to offer aesthetics and fracture toughness. These crowns are however abrasive and can result in significant wear in the opposing natural dentition unless the opposing dentition also has a densely sintered ceramic biting surface. These crowns must be carefully engineered on guiding surfaces to prevent excessive tooth wear.

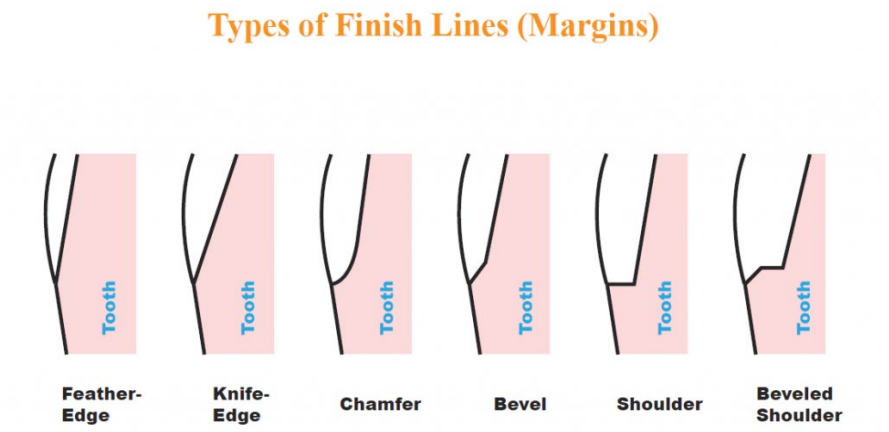
- A ‘hybrid’ restoration is the ‘porcelain-fused-to-metal’ (PFM) restoration. This restoration has a core in metal, typically palladium, or Nickel Chrome, or Cobalt Chrome, and sometimes gold, but which has porcelain used to the whole or part of the surface. In certain situations, where it is desirable to have a metal ‘biting-surface’ but an aesthetic porcelain facing surface, such as hybrid restoration can be manufactured.

- A CAD/CAM ‘chair-side’ milled crown or inlay is sometimes recommended. These are made of fused ‘feldspathic’ porcelain. These restorations are excellent when the material is applied in bulk for the heavily broken-down tooth. They can also be fabricated at the chairside

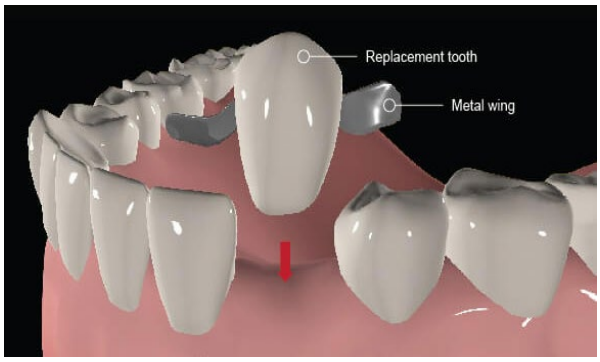
The various materials require different ‘finishing lines’ based on the material properties. The finishing lines play a large part in how much bulk tissue removal will be needed as part of the crown preparation procedure. Typically, a crown preparation procedure requires use of a drill to create carefully constructed line angles so that a prospective crown inserts in one definite line of draws.

Occasionally a metal margin needs to be visible and ‘bulked-up’ to provide strength for the restoration and to minimise the extent of bulk tissue removal as part of the procedure.

There are many permutations that a dentist will consider before making a recommendation on the type of crown, inlay, onlay or bridge unit that would be most suitable for your mouth.



Adhesive Bridgework (resin-bonded bridge)



The adhesive chemistry of our materials used in conjunction with a carefully managed bite can allow dentists to fabricate bridges which do not require preparation. The so called 'resin-bonded' bridge (traditionally called a 'Maryland' bridge) is made of Nickel-chrome in this section. This material is very rigid and does not excessively when constructed in thicknesses of 0.8 mm and above. The material will bond very tenaciously to enamel with a so-called 'bi-functional' adhesive resin cement. These bridges can be usefully applied to smaller tooth spaces where there is an adjacent healthy tooth with a large surface area of unrestored enamel which can be bonded to. The large surface area of enamel receives a wide coverage, 0.8 mm thin Nickel-chrome retainer which bonds over it and has a 'cantilever' section which is covered in porcelain and artistically manufactured to look like a tooth.

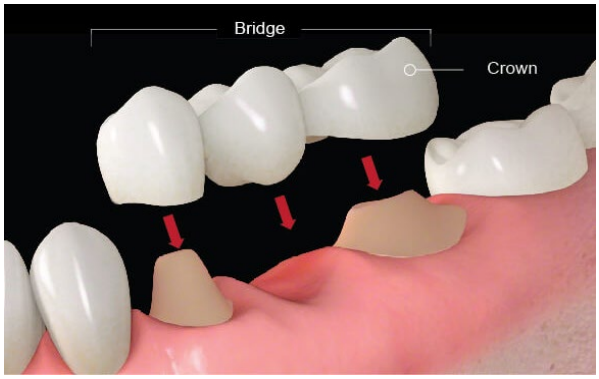
With careful photography and a considered prescription to the technician, the pontic can be made to look very life-like and the pontic space will look like a natural tooth emerges from this space. Whereas such an adhesive bridge needs to be used carefully, it will function as if a natural tooth. Whereas it is possible to create a very natural looking tooth it is very important to realise that the abutment tooth is covered significantly by a dark silver-based retainer and this will mildly show through thin teeth as a very faint 'greying out'. It is impossible to prevent this and sometimes the extent of 'grey show through' is not obvious until you present your smile directly to good quality light.

Whereas research has indicated that zirconia (a white-opaque durable material) can be used and bonded to tooth structure resulting in no grey 'show-through' this material has to be manufactured more thickly and due o its abrasive surface can abrade adjacent teeth and cause excessive tooth wear against guiding tooth surfaces.

The bridge needs to be constructed in a manner where the pontic is not a guiding surface to prevent stress on the resin and retainer surface which is bonded to the enamel face.

Conventional Bridgework

A bridge is where one or more crown units are placed on prepared abutment teeth to restore 2 or more teeth. The artificial tooth is known as a pontic.



There are several designs:

- The single cantilever bridge is where two teeth are replaced, and a crown is fixed onto a single tooth abutment. The abutment must have a strong enough core and a long enough root to carry two teeth. It is important that the pontic does not carry the load otherwise the whole bridge will break
- The fixed-fixed bridge occurs where typically two teeth abutments are prepared parallel to each other to receive a 3-unit prosthesis. It is entirely possible for two good quality abutment teeth to carry more than just 2 pontic teeth. With the profound success of dental implants, dentists tend not to recommend placing large bridges on fewer abutment teeth
- Exceptional cases. A dentist and a patient may stray from traditional design and mechanical principles to produce a bridge which has a limited prognosis but a very definite short term functional goal. The dentist and patient will agree such a strategic goal, knowing the limited prognosis as a phased plan towards dental implants at a future date.

The preparation procedure itself

A well-executed crown, inlay or onlay is a carefully planned procedure:

- Local anaesthesia is typically used
- A drill is used to shape the residual tooth structure. Much water spray and suction is used. The tooth structure needs to be carefully shaped according to the required mechanical properties of the chosen crown
- In the case of an adhesive bridge, little (if any) tooth structure will need to be removed from the abutment tooth
- A new core or a post space may be drilled at the same time as preparing for the prosthetic unit
- The crown margin needs to be refined and if this is under the gum line, then this needs to be carefully trimmed with a dental laser to reveal the ‘finishing line’ for the crown
- Occasionally a cord is used (known as ‘retraction cord’) which is soaked in a tissue shrinking agent and this is carefully packed around the gum to separate the gum tissue from the hard tooth tissue to reveal a ‘finish line’ that needs to be captured by an impression of the tooth. In revealing the ‘finish-line’ it is possible that gum bleeding will occur. This is a problem as the gum bleeding/oozing can prevent an accurate impression from being captured
- An impression will be taken using a traditional impression procedure or your tooth may be scanned using a digital scanner using a digital impression technique
- If your tooth is vital, the dentine is sealed with a resin before making a temporary crown
- After completion of the preparation, a temporary or ‘provisional’ crown is made freehand or made from preparatory work at the laboratory
- When multiple units are being fabricated at the same time, the technician may have been asked to make some temporary crowns which are to be relined at your crown preparation visit. Alternatively, the technician will have created a digital model and a ‘stent’ or ‘matrix’ to help the dentist construct the provisional crown/s
- The provisional crown will then be cemented with a weak cement
- Typically, 2 weeks later, the provisional crown is removed and the definitive crown is tried in for accuracy of fit before being cemented
- CADCAM based crowns are milled at the chair side and are fitted straight away

- Occasionally, the dentist will want to construct a 'long-term' temporary so that he/she can focus on additional allied work and the definite crowns are being fitted several weeks/months later after evaluation of the outcome of associated dental work.

What can go wrong?

There are several complications that can occur as a result of a CIOB procedure:

- When preparing the core, the dentist identifies that there is very little residual tooth structure and a crown preparation procedure tuns into an extraction
- During the crown preparation procedure, further weakened tooth structure breaks and the tooth become irrational to treat, and the tooth then needs to be removed in favour of an alternative procedure
- During the interim period between placing a temporary crown and fitting the definitive crown, the provisional crown can dement and be lost, swallowed or inhaled. Inhalation of temporary crowns is very rare.
- During the interim period it is common for the patient to experience sensitivity
- If a 'post-space' is being created for a post crown, it is entirely possible for the root to fracture of the post space to result in perforation of the side of the root resulting in a poor prognosis abutment that needs to be removed
- As a result of the preparation procedure the nerve of the tooth dies, and the tooth then with its new crown as to have a hole drilled through the tooth to remove the nerve and perform a root canal treatment. A crown can usually be repaired through the root canal without needing to be replaced, although this is a much better option to provide a seal from ingress of bacteria
- Where a patient has a heavy bite, typically associated with bruxism/grinding it is possible that a completed crown will be sheared off resulting in a completely fragmented abutment and a tooth which now needs to be removed
- It is possible that the microtrauma associated with the tooth preparation will result in gum recession and the margin of the new crown will show a few weeks/months later. This is not always predictable and occurs more in individuals with a thin gum expression (known as a thin 'periodontal' phenotype). The transition in colour will be more obvious if a metal-based crown such as palladium, or Nickel chrome is used as these crowns have a silver texture.

Charges and Fees

The dentist will make charges very clear and will itemise charges that are relevant to:

- Preparatory work in relation to decay management, gum disease management, bite management, or crown lengthening
- Fees in relation to preparatory digital smile design or lab made provisional crowns
- Fees associated with placing a post or new core
- Fees associated with the different crown materials

This guide is intended to help the patient realise the range of options and associated planning that is required for a crown procedure, and to help explain the cost element of each of the multiple stages for more complicated crown procedures.