3 Implant systems

Implantology to date has enjoyed a progressive, albeit rapid, development, with over 250 implant systems with different designs and features available on the market. Some of these systems are well researched with documented evidence of their success; others, however, have little or no published data to support them. This rapid expansion has been driven by patient as well as clinician demand as the predictability and success rates of endoosseous dental implants have improved. In response to these demands, different companies have competed to introduce products aimed at achieving shorter treatment times and improved aesthetics, thus enabling teeth to be replaced in a day. Chapter 2 provided an overview of the concepts of osseointegration and the components of modern-day implantology. This chapter focuses on five of the more commonly used implant systems. Although there are minor variations in the names of products and components used by different companies, the basic concepts remain the same. An overview of the basic outline of the systems is given; however, the different types of motors used for surgical procedures are not covered.

The systems

The systems covered are:

- the Brånemark System® marketed by Nobelbiocare
- the Straumann System marketed by Straumann
- the Frialit 2, XiVe and Ankylos systems marketed by Dentsply Friadent

- the 3i System marketed by Implant Innovations
- the Astra System marketed by Astra Tech.

We will focus on the different components of the systems and the key differences between them. Each system has three main categories of product line: the surgical components, prosthetic components and the instrumentation needed for the implant placement and restoration. All the systems also have different types of planning kits, the details of which are beyond the scope of this chapter.

The Brånemark System®

This was the first osseointegrated implant system that was to receive worldwide recognition and it has today changed the way endoosseous implant treatment is undertaken. This system was first introduced in 1980 with a kit that enabled the placement of dental implants into the jaw bone of edentulous patients to support dentures. The fixtures that were supplied at the time were designed by Professor Brånemark in conjunction with one of his co-workers and were first marketed under the name of Nobelpharma in 1982. This company established stringent manufacturing criteria and produced the first products in 1982, which were used by practitioners. In 1985 the company changed its name to Nobel Industries and the Brånemark System® was named as such in 1990. Subsequently, when the company took over the Sterioss implant system, the name changed to Nobelbiocare. Today the two implant systems marketed by this company are the Brånemark System® and the Replace Select System. The latter is the internal connection system that is marketed by the company and at present appears to be taking over the market share of the Brånemark System®. This chapter will only cover the Brånemark System®.

When it was first marketed, the Brånemark System® followed stringent protocols of design and equipment. Whilst the early equipment was cumbersome and complex, the system has now been streamlined, with a significant reduction in the number of instruments and drivers needed both for the surgical and the prosthetic aspects of treatment. Over the past 20 years, the system has seen a vast change in the product line, with different types of implants available for different situations.

Implants

The company provides fixtures for extra-oral as well as intra-oral use. This chapter focuses on the intra-oral components. The implants for intra-oral use have an external hex connection and are designed as parallel-walled implants with an apical cutting flute that minimizes trauma during placement (see Fig. 3.1).

The implants are provided in a range of lengths from 7 to 20 mm; however, the most commonly used lengths today range from 10 to 15 mm. The implants are available in a choice of diameters, with the smallest being 3.3 mm – the

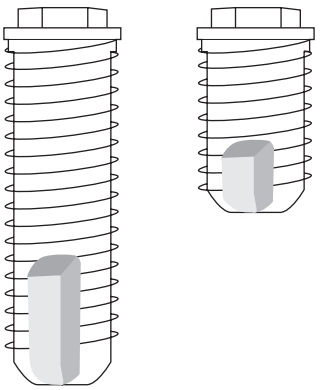


Figure 3.1 Brånemark fixtures with the apical self-cutting thread and the external hex connection

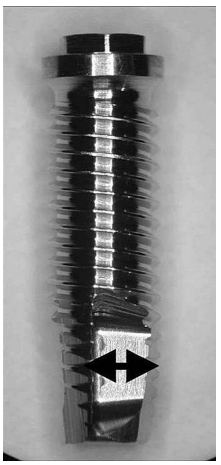


Figure 3.2 Pure machined Brånemark fixture

narrow platform (NP); the 3.75 and 4 mm diameters – the regular platform (RP) and finally 5.0 and 6.0 mm diameters, the wide platform (WP). Recently the company has introduced a short 5.5 mm length implant called the 'shorty', which is also available in all the diameters.

All the fixtures are available as Mark III implants for use in all types of bone and as Mark IV fixtures primarily designed for use in type IV bone. The surface finish of the implants was originally a pure machined titanium surface (see Fig. 3.2), but today this surface has been superseded by the Ti-Unite® surface. The implant surface topography is changed by putting the implant through an oxidation process, which results in a porous and thicker titanium oxide layer. It is this layer that increases the surface area over which the bone cells can grow and integrate (see Fig. 3.3).

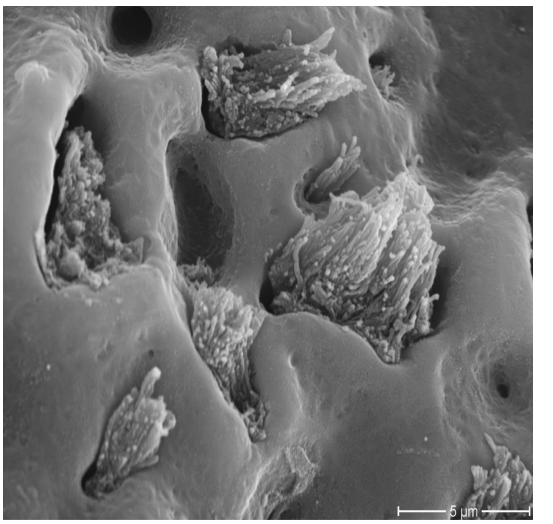


Figure 3.3 Electronmicrograph showing the Ti-Unite surface, which is prepared by an oxidation process that results in a porous and thicker titanium oxide layer

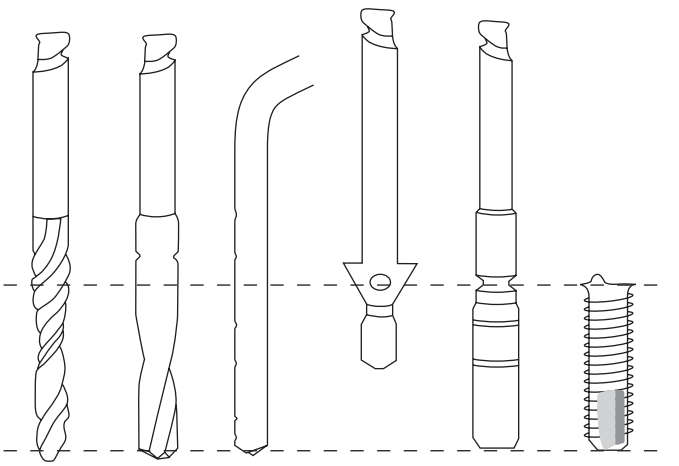


Figure 3.4 The drilling protocol of the Brånemark system

The original implants marketed as Mark II had to be tapped into place using a screw tap. This soon changed with the introduction of the Mark III implants, which were self-tapping with the special cutting thread apically. The drilling sequence for the site preparation remains similar to that discussed in Chapter 2 (see Fig. 3.4). A pilot drill was used in the original drilling protocol, but this seems to have been eliminated from the recent drilling protocol. The company produced disposable one-use-only drills to eliminate the repeated use of

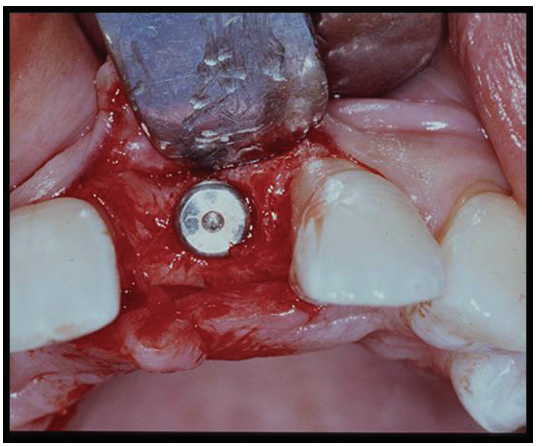


Figure 3.5 Clinical picture of a Brånemark fixture in situ showing the external hex at the level of the alveolar crest

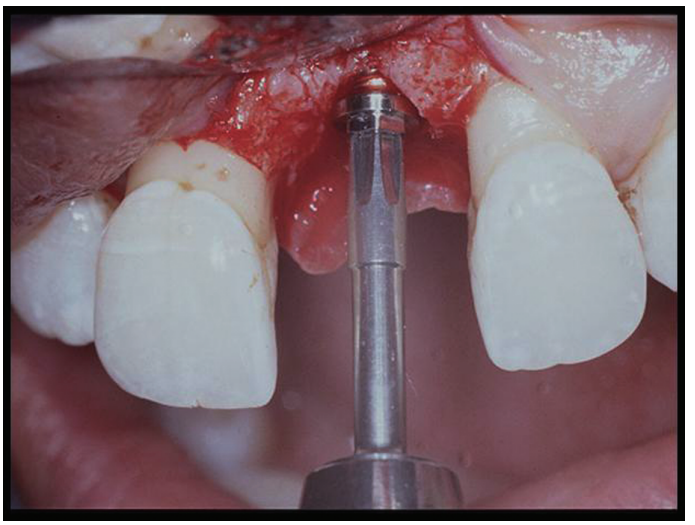


Figure 3.6 Fixture being placed with the fixture driver

blunt drills, which could overheat the bone and compromise the site preparation and ultimate success of the fixtures. The final step in the site preparation is the use of the countersink or 'counterbore' as it is now called. This is used to enable the implant to be placed such that the external hex connection sits in line with the alveolar crest (see Fig. 3.5). The first implants were premounted, and once placed the fixture mounts had to be removed. This step has now been eliminated with the implant driver being designed such that the implant can be picked up directly, eliminating the need to remove the fixture mount (see Fig. 3.6).

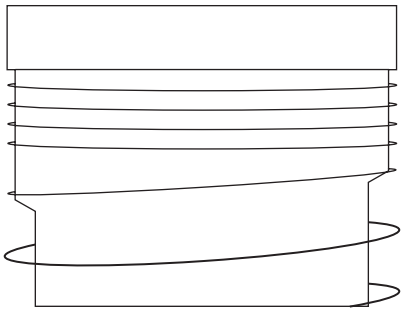


Figure 3.7 The groove fixture showing the threads extending higher up on the fixture

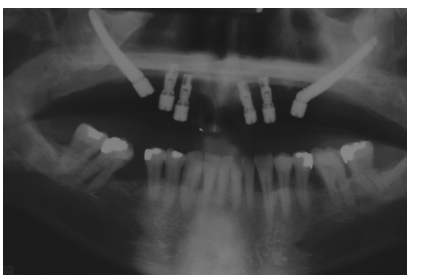


Figure 3.8 Zygoma implant

Position indicators and depth gauges are used to check the drilling depth and fixture alignment during site preparation. All the implants are supplied with a cover screw. The latest change within this system is the change in the configuration of the grooves on the implant surface. The threads are much higher up on the implant surface and extend onto the implant collar (see Fig. 3.7). The grooves have been incorporated to enable more rapid bone formation, thus enabling the implants to integrate faster. The grooves also provide a better mechanical interlock, improving primary stability. The system also has the 'zygoma' implant, which has similar features to the implants covered above (see Fig. 3.8).

The company has also introduced a number of other implants to the market to meet demand. Other implants that are being marketed are the 'nobelspeedy', which allows for flapless surgery and has a slight taper. Other concepts are 'implants in a day' (when the implants are inserted and the prosthesis is also connected at the same time so that patients leave the surgery with their teeth) and the 'nobelguide' treatment concept (where specially made customised surgical guide is used to transfer the planned treatment to the patients mouth such that an exact replica of the prosthesis is delivered).

Prosthetic components

The original Brånemark System® had a number of prosthetic components (see Fig. 3.9a). The first abutments were the standard abutment (see Fig. 3.9b), the ceraone abutment (see Fig. 3.9c), the aestheticone abutment (see Fig. 3.9d) and the mirus cone abutment for sites with minimal space. In addition two angulated abutments are also available. These are the preformed abutment and the custom abutment, a UCLA type (see Fig. 3.9e) is also available. The preformed abutments have now been replaced with multiunit abutments, which the company says are compatible with previous abutments (see Fig. 3.10). The system has impression copings for fixture level impressions as well as abutment level impressions (see Figs 3.11a, b). The abutments screws are tightened to a torque of 20 Ncm and the prosthetic screws to a torque of 10 Ncm, with the exception of the ceraone abutment screw, which should be tightened to 35 Ncm.

Instrumentation

The cumbersome equipment that was needed for implant surgery when first introduced was replaced in the mid-1990s with compact and more user-friendly instrumentation kits (see Figs 3.12a, b). The kits of today are colour coded and extensively simplified, thus making them easier to use. The kits available are the surgical kit, the second-stage surgery kit and the prosthetic kit. The torque drivers were originally machine driven, but the hand-held torque driver has now largely replaced the old machine-driven driver.

The Straumann System

This system is Swiss, with Straumann having an interest in metallurgy and precision mechanics. The company has close links with the International Team of Implantologists (ITI), a group that undertakes independent research in the field of implantology. The first implant, called the Boneloc implant, was developed in the mid-1970s by Andre Shroeder and his team. This was a hollow cylinder implant and they confirmed that direct bone to implant contact can occur under the correct conditions. As a result of this finding, in 1985 the one-part and two-part hollow cylinder and hollow screw fixtures (implants) were manufactured. Because of problems with fracture, the hollow cylinder implants were subsequently replaced in the early 1990s by the solid screw implants.

Implants

The company provides implants for extra-oral and intra-oral use and they also have an orthodontic implant. The fixture is designed as a cylindrical implant with an internal octagon connection, which also has a morse taper. The morse taper provides the antirotation with a reliable and stable implant-to-abutment joint, whereas the internal octagon confers flexibility but also ensures accurate

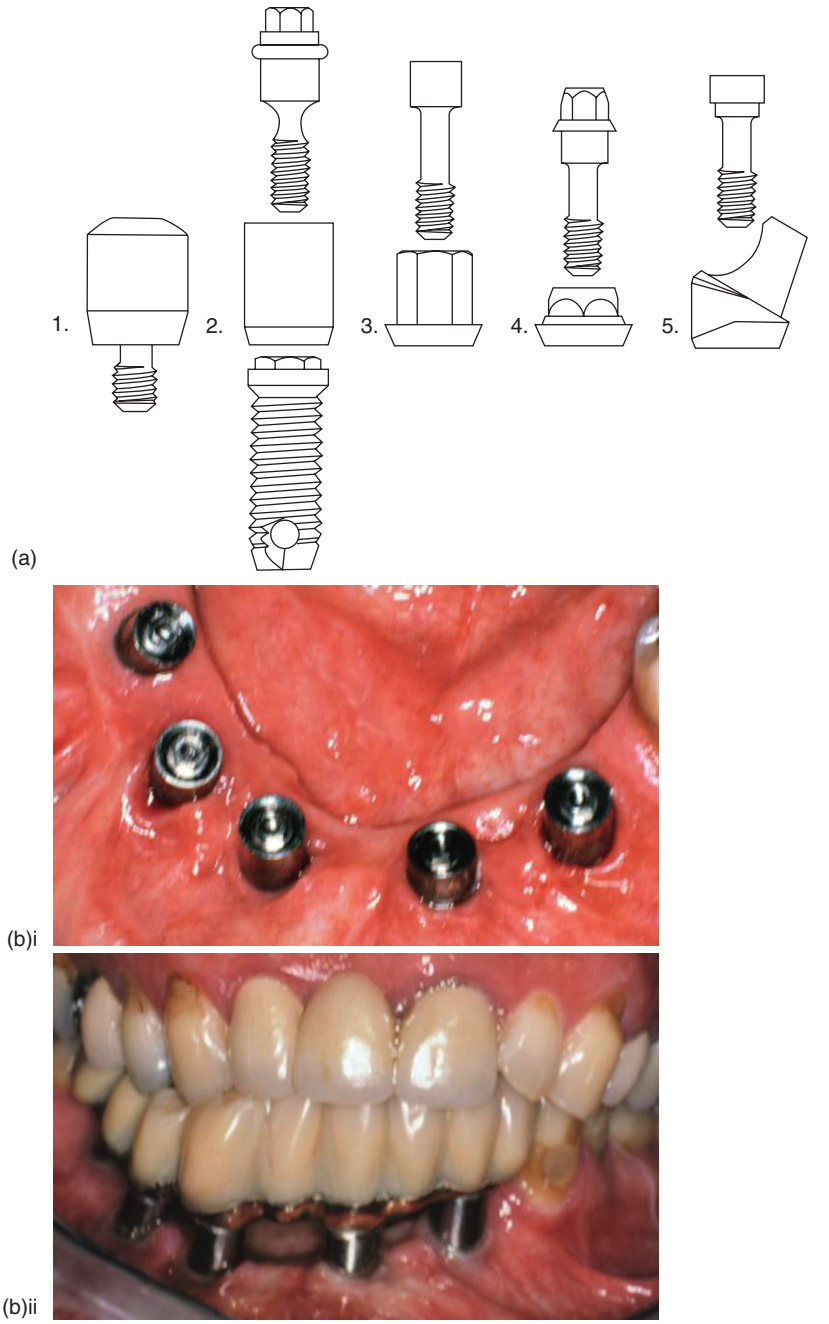


Figure 3.9 **(a)** 1, healing abutment; 2, standard abutment; 3, ceraone abutment; 4, aestheticone abutment; 5, angulated abutment. **(b) (i, ii)** Standard abutments in clinical use retaining a fixed prosthesis.

(c)

(d)

(e)

Figure 3.9 *Continued* **(c)** Ceraone abutment used for the replacement of a single tooth. **(d)** The aestheticone abutments used for replacing multiple teeth. **(e)** Custom abutment seated in the mouth

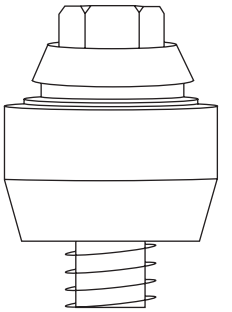
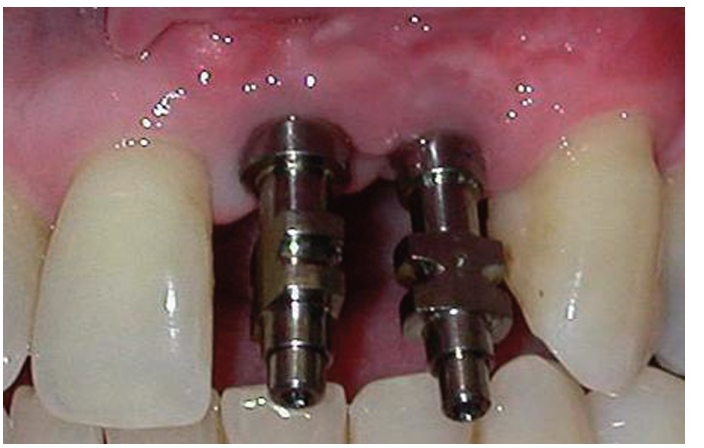


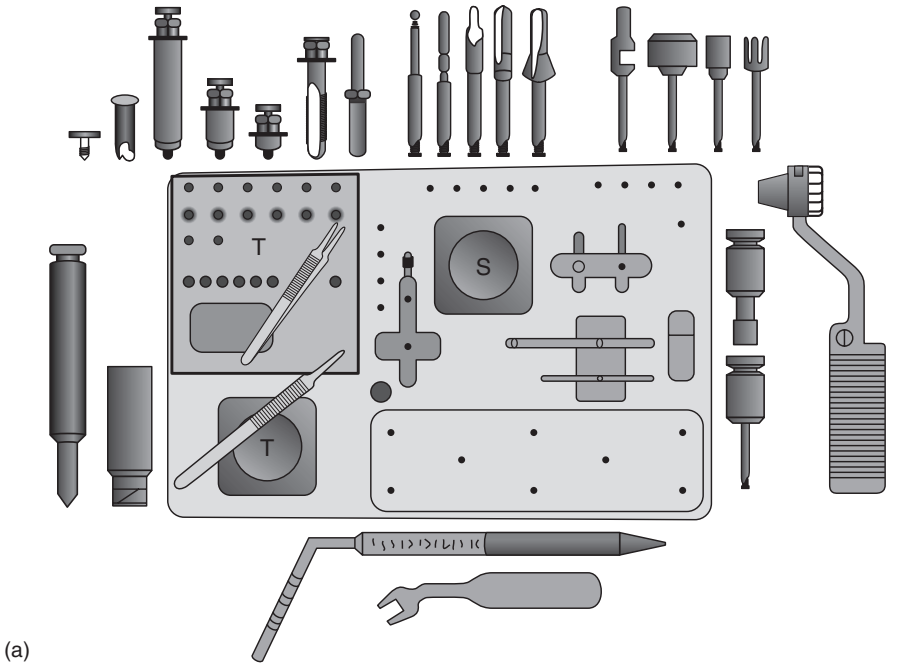
Figure 3.10 The multiunit abutment

(a)



(b)

Figure 3.11 Different impression copings for **(a)** fixture level and **(b)** abutment level impressions



(a)

(b)

Figure 3.12 **(a)** The old surgical instrumentation set compared to **(b)** the newer set

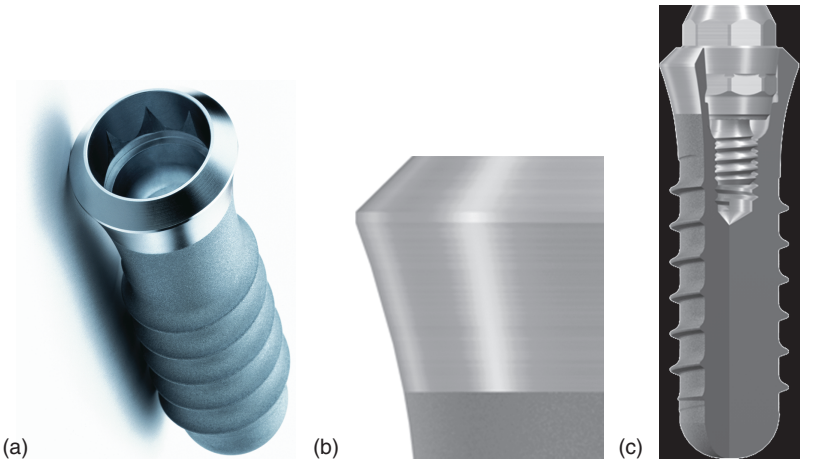


Figure 3.13 **(a)** Straumann fixture showing the internal connection. **(b)** The bevel that minimizes the microgap and allows for optimal load distribution. **(c)** The 8° Morse taper that provides the anti-rotation and a stable implant to abutment join

repositioning of the prosthesis. The 45° beveled shoulder allows for optimal load distribution and minimizes the microgap between the implant and the prosthesis. Primarily designed for use as a one-stage system, the main difference with this system is that the implants have the polished collar integrated into the body of the implant, which allows for soft tissue adaptation during healing after the surgical placement of the implant (see Figs 3.13a, b, c).

The implants are provided in a range of lengths, starting at 6 mm with the longest being 16 mm. The most commonly used are the 10–12 mm lengths. The 6 mm implant is only used when it is connected to other implants. The family of implants is available in three lines: standard, standard plus and tapered effect (TE) (Fig. 3.14). The main difference between the standard and standard plus implants is the height of the polished collar. The standard implant has a 2.8 mm polished collar whereas with the standard plus (previously called the aesthetic plus) the polished collar is reduced to 1.8 mm. This implant is advocated for use mainly in the aesthetic areas. The TE fixture has a special design and is advocated for used for immediate implantation. It has a slight coronal flare, which is thought to confer better primary stability by engaging the cortical plate coronally. All the implants are available in a choice of three diameters: the narrow body of 3.3 mm diameter, the regular body with a 4.1 mm diameter and the wide body with a 4.8 mm diameter (see Figs 3.15a, b, c).

The prosthetic platform diameters are, however, different and are available as 3.5 mm diameter (narrow neck, NN), 4.8 mm diameter (regular neck, RN) and 6.5 mm (wide neck, WN) diameter (see Figs 3.16a, b, c). The narrow neck, because of its size, is an external connection and is only available on the narrow body implant (3.3 mm). The regular neck is available on the narrow body

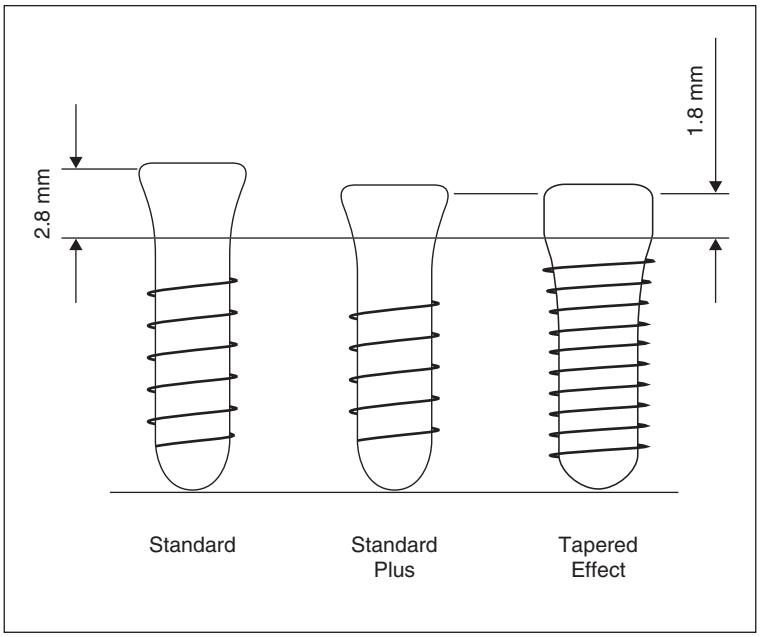


Figure 3.14 The family of Straumann fixtures showing the standard, standard plus and tapered effect fixtures

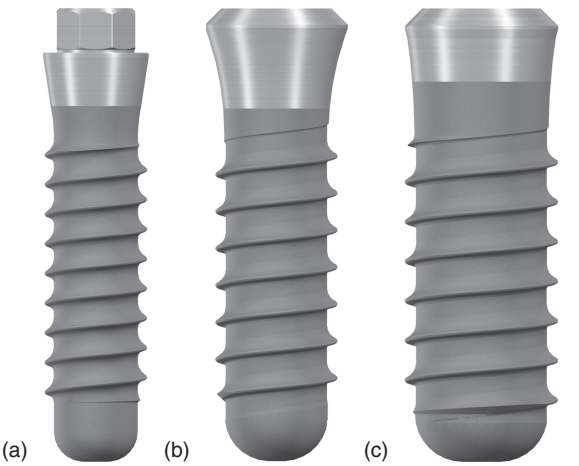


Figure 3.15 **(a)** The narrow body fixture with a 3.3 mm diameter, **(b)** a regular body fixture with a 4.1 mm diameter and **(c)** a wide body diameter of 4.8 mm

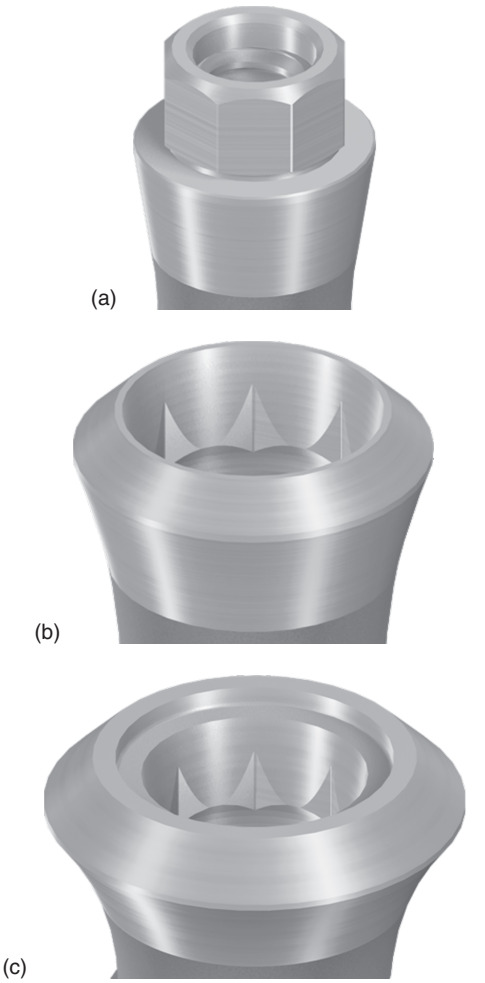


Figure 3.16 The different range of prosthetic diameters from **(a)** 3.5 mm as the narrow neck, **(b)** 4.8 mm as the regular neck and **(c)** 6.5 mm as the wide neck. Note that the narrow neck fixture has an external octogon connection

(3.3 mm), regular body (4.1 mm) and wide body (4.8 mm). The wide neck is only available on the wide body (4.8 mm).

The original implant surface was titanium plasma sprayed (TPS) (see Fig. 3.17) and needed up to 12 weeks for integration to occur. To meet the market needs of shorter healing times this surface was replaced with the sand-blasted large grit acid-etched (SLA) surface in 1994 (see Fig. 3.18). The implant was put through a process of large grit sand blasting with a conundrum of particles and then acid etched with hydrochloric and sulphuric acid to create micropits on the implant surface. These micropits were associated with improved integration and

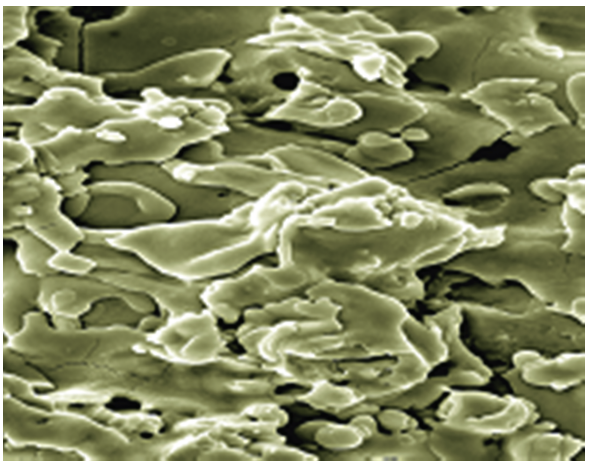


Figure 3.17 Electronmicrograph showing the titanium plasma-sprayed surface of the Straumann implant

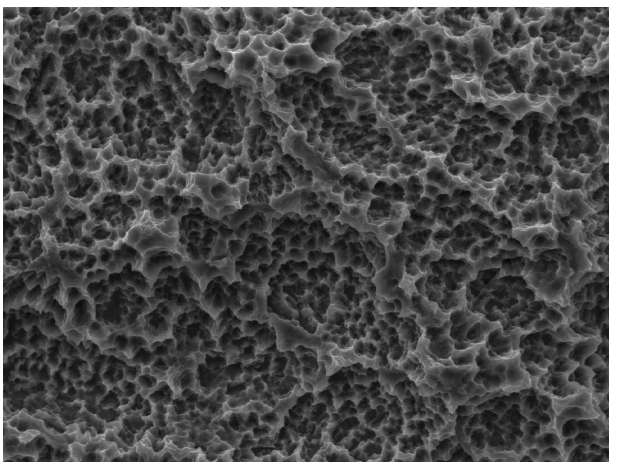


Figure 3.18 Electronmicrograph of the sand-blasted large grit acid-etched surface of the Straumann implant. Note the difference compared to the previous implant in the surface area. The SLA active surface is an enhanced surface of the SLA aimed at improving the osseointegration rate

shorter healing times, reducing the healing time for the implant to integrate to 6–8 weeks. More recently this surface has been modified again and implants with an SLA active surface have been introduced. This is a hydroxilated (chemically active) surface, which provides ideal conditions for direct protein absorption and thus immediate initiation of osseointegration. This macro- and microstructured osseoconductive surface therefore reduces the healing times for integration to 3–4 weeks.

Figure 3.19 The Straumann round and twist drills used for site preparation. Note the black markings on the twist drills, which indicate the depth to which the site is being prepared

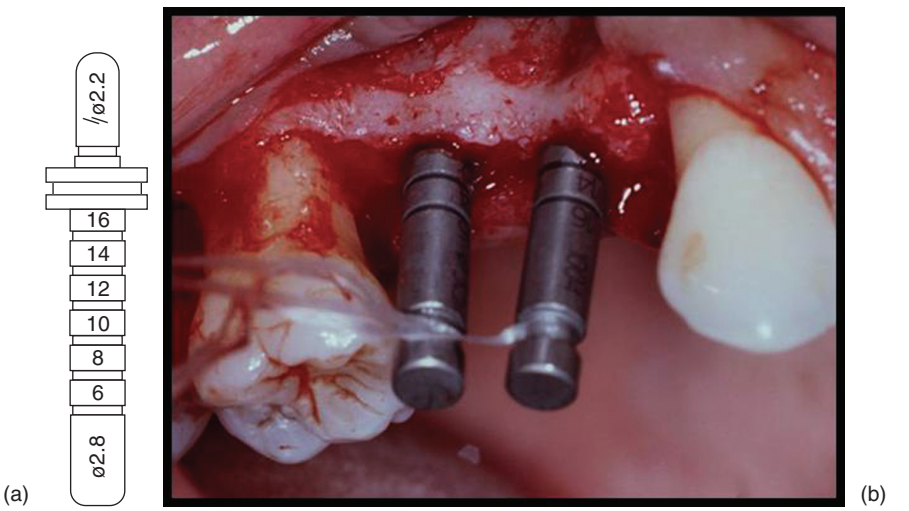


Figure 3.20 **(a)** The alignment pin and **(b)** the pins in situ during site preparation, verifying the fixture position

The drilling sequence of the implants remains the same as detailed in Chapter 2, but for the standard plus implants a profile drill (similar to the countersink) needs to be used for the emergence profile. With the TE implant a cortical drill has to be used to facilitate the preparation of the coronal part of the site to enable the tapered part of the implant to engage the cortical bone. Fig. 3.19 shows the drill sequence (the profile drill is not included in this figure). This system has depth gauges, which are also used as direction indicators and are called 'alignment pins' (see Figs 3.20a, b). The fixtures are pre-mounted and the

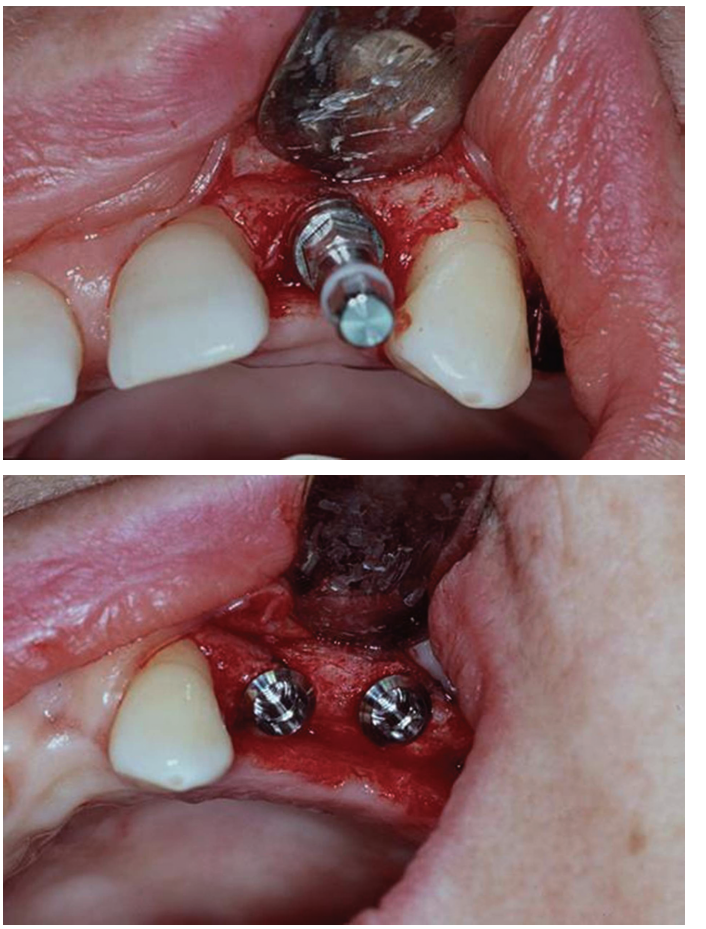


Figure 3.21 The fixture mounts **(a)** in situ and **(b)** after removal

mount needs to be removed once the implant is inserted (see Figs 3.21a, b). The other implants available are the extra-oral (see Fig. 3.22) and the orthodontic implants, which can be used for anchorage when there is an inadequate number of teeth (see Fig. 3.23).

Prosthetic components

This system has three categories of abutments: the solid abutment (see Fig. 3.24a), the synocta abutment (see Fig. 3.24b) and the angulated abutment (see Fig. 3.24c). The abutments for narrow neck implants are different and have an external connection. The abutments are available both for cementable and screw-retained restorations. The same screw driver (see Fig. 3.25) is used for all prosthetic parts. The abutments are screwed into the implant and torqued to

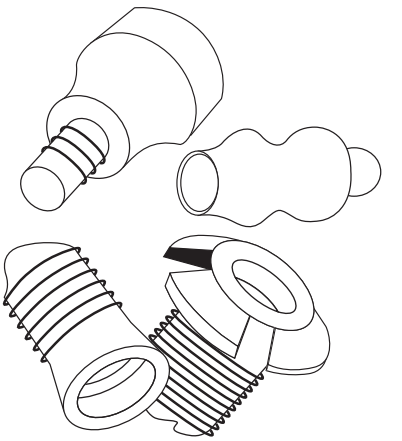


Figure 3.22 Extra-oral Straumann implant

Figure 3.23 Orthodontic Straumann implant, which is used in cases where there is an inadequate number of teeth for anchorage

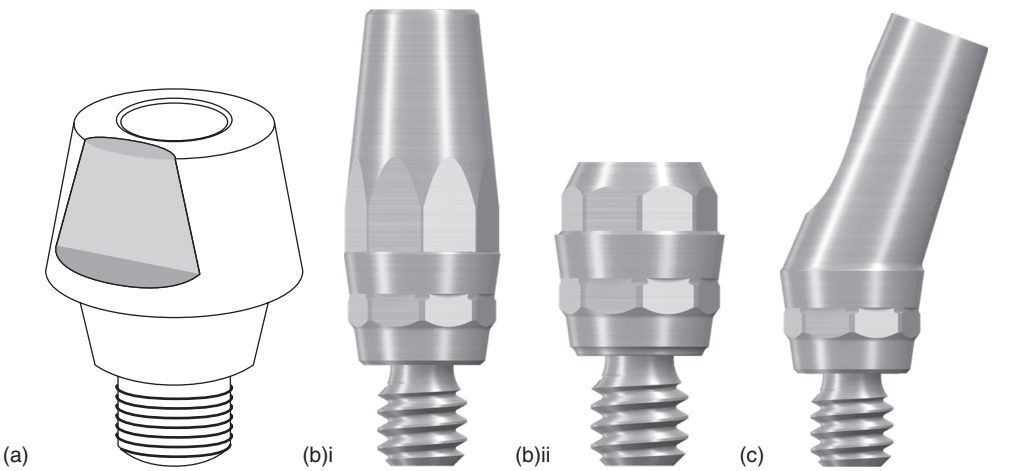


Figure 3.24 **(a)** Solid abutment. **(b)** The synocta abutments for **(i)** the single unit and **(ii)** multiple unit restorations. The former is designed with antirotation to stop the abutment from rotating on the fixture. **(c)** Angled abutment

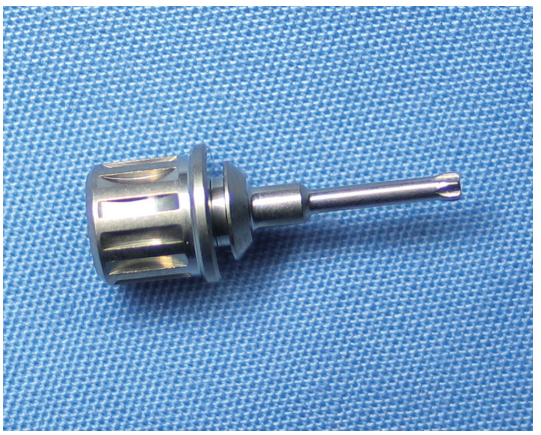


Figure 3.25 Standard screw driver, which is used for all prosthetic connections with the exception of the locator and ball and socket abutments

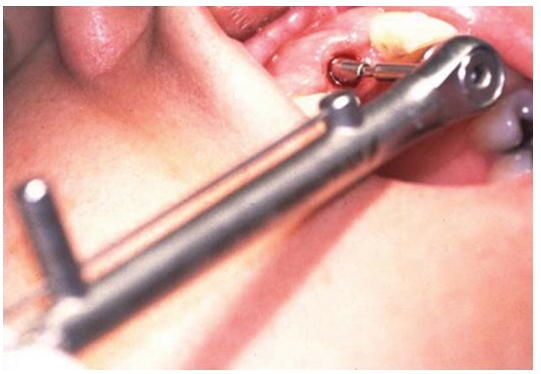


Figure 3.26 Manual torque wrench used to tighten the abutment and prosthetic screws

35 Ncm using a manual torque driver (see Fig. 3.26). The prosthetic screws for the screw-retained restoration are torqued to 15 Ncm. The impression copings are called transfer caps and are available for use at fixture or abutment level. The caps are available in metal or with a white plastic basket and positioning cylinder for both the implant (see Figs 3.27a, b) and abutment level impressions (see Figs 3.28a–e). Once the impression has been taken the analogues are positioned and the cast is poured for the construction of the prosthesis.

Instrumentation

The surgical tray is colour coded with the coloured lines showing the drilling sequence (see Fig. 3.29). The arrowed lines make it easy for nurses to find the

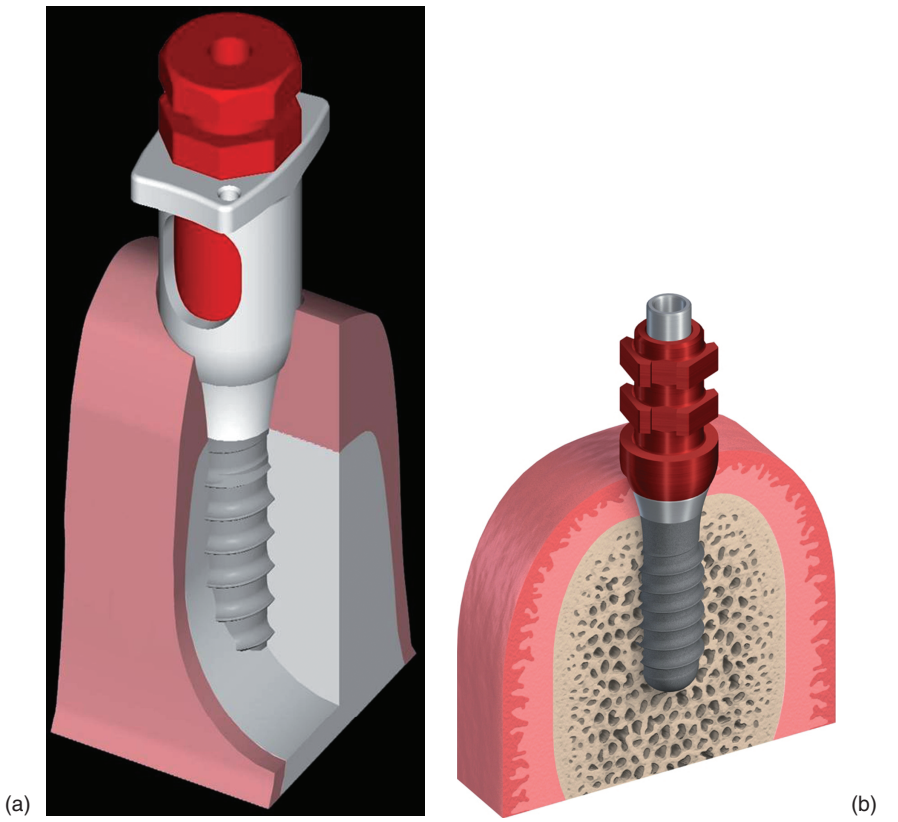
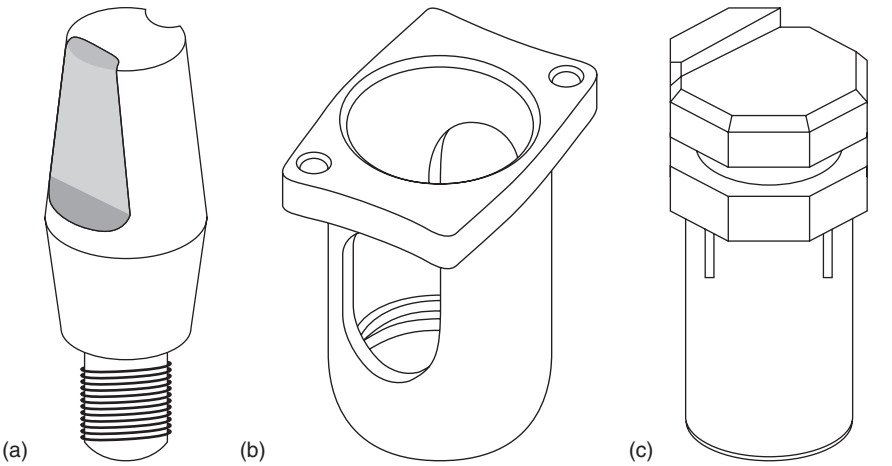


Figure 3.27 **(a)** White basket and red positioning cylinder fixture level transfer cap. **(b)** Metal screw fixture level impression coping

next component that is needed during site preparation. The prosthetic kit is also compact because only one screw driver and one torque driver are needed.

The Frialit 2 and XiVe systems

The Frialit 2 and XiVe are German systems and the implants were originally marketed by Friadent in the UK but have been bought over by Dentsply (in 2000). The Frialit®-1 implant, also known as the Tubigen implant, was made from aluminium oxide and initiated under the leadership of Professor Dr Willi Schulte in 1974. The concept behind this implant was to design it as a root-form implant, so that it could be immediately inserted into the bone at the time the tooth was extracted. The original ceramic implant was replaced in 1992 with the Frialit 2 (F2) implant because of problems with fracture and failure. Since the introduction of this implant, newer implant lines have been introduced.



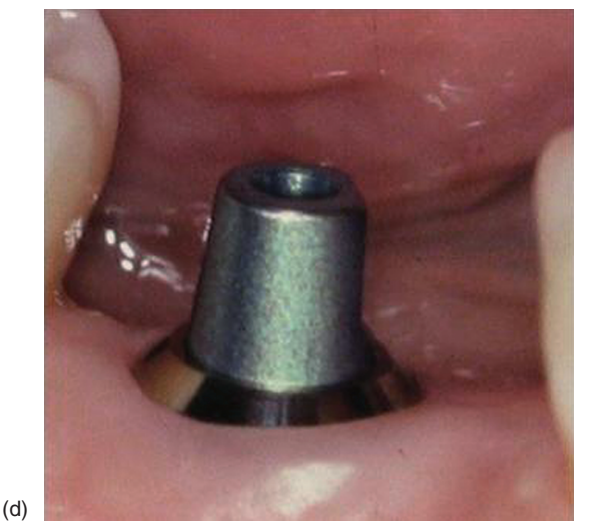


Figure 3.28 **(a–e)** Abutment level impression coping. The positioning cylinders are colour coded to match the solid abutment heights

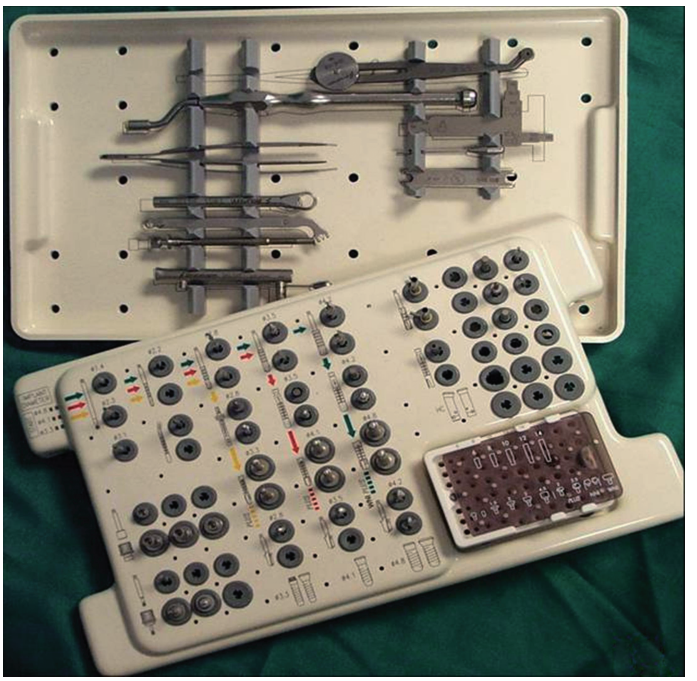


Figure 3.29 Surgical kit showing the coloured arrowed lines that indicate the drilling sequence

Although the IMZ implant is still around, its use has largely diminished and it will therefore not be covered here. This was the first implant system that used colour coding for easy identification of the different component parts.

Implants

F2 implants are available as root analogue stepped cylinders or stepped screws (see Fig. 3.30). The XiVe fixture (see Fig. 3.31) was introduced in 2003 as a parallel-sided implant with slight changes in the design to achieve the highest primary stability in all bone qualities. This was achieved by changing the apical thread configuration to deeper threads and incorporating a slightly wider crestal part to facilitate improved primary stability. The implants are made from commercially pure titanium and are designed with the same internal configuration connection as each other (see Fig. 3.32).

The fixtures have a precut thread to facilitate ease during placement, thus eliminating the need for a screw tap. The implants also have a polished collar coronally to provide flexibility for use as either a one or two-stage placement.

The F2 fixtures are available in four lengths (8, 11, 13 and 15 mm) and four diameters (3.5, 4.5, 5.5 and 6.5 mm) to match the diameter of the tooth that is

Figure 3.30 The Frialit 2® stepped push fit and screw implants

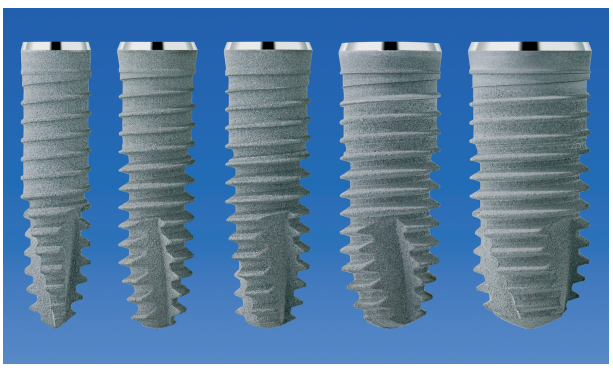


Figure 3.31 The XiVe® implant with the more pronounced threads apically and slightly wider crestal diameter to offer improved stability when placed

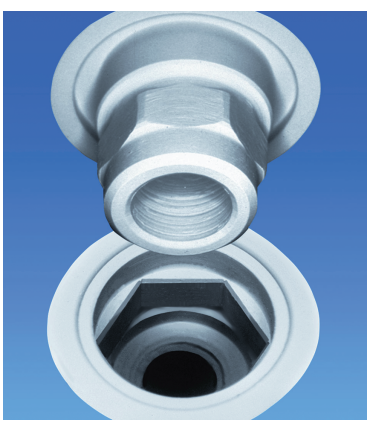


Figure 3.32 The internal connection of the XiVe® and Frialit 2® fixtures

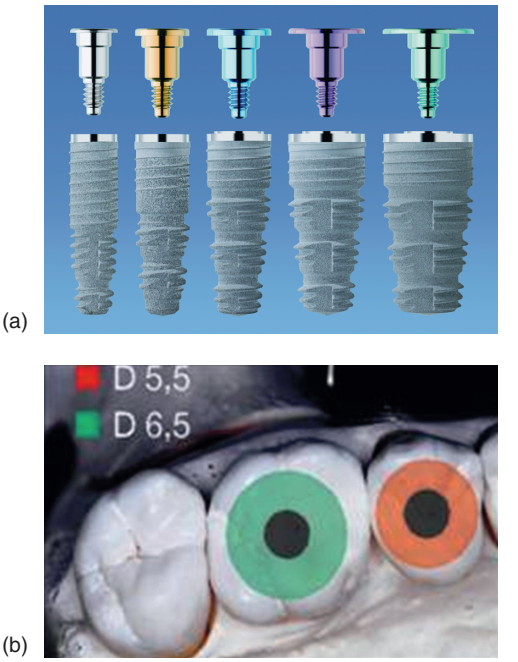


Figure 3.33 **(a)** The range of diameters with colour-coded cover screws. **(b)** The colour coding showing the relationship of the diameter to the size of the tooth

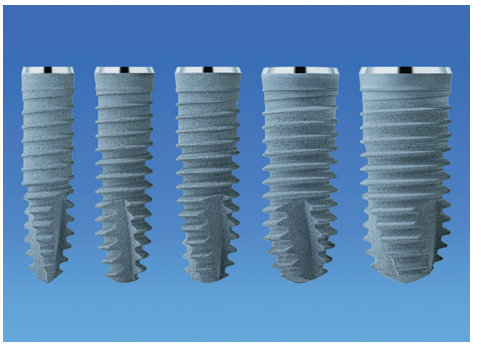
being replaced (see Figs 3.33a, b). The XiVe fixtures are available in lengths of 8–18 mm and diameters of 3.0–5.5 mm (see Fig. 3.34a). Each diameter configuration is colour coded with the colour scheme applied throughout the whole range of components (surgical to prosthetic) for that particular diameter (see Fig. 3.34b).

The original surface of the implant was a titanium plasma-sprayed surface (see Fig. 3.35), which was replaced by a deep profile, grit-blasted acid-etched surface. This surface has now been superseded by the 'cell plus' acid-etched surface (see Fig. 3.36), which shortens the healing time. Implant placement is undertaken using a series of standardized drills with internal irrigation. The drills for the F2 are stepped drills (see Fig. 3.37). The XiVe drilling sequence is the same, but an additional cortical drill has to be used to prepare the cortical part of the site (see Figs 3.38a, b, c).

Prosthetic components

The prosthetic components for the two systems are the same due to the same internal connection configuration. Different abutments are available and are either preformed (see Fig. 3.39) or customized. The latter is called the aurobase abutment (see Fig. 3.40). The prosthetic kit is compact, with a small range of screwdrivers needed for the prosthetic components (see Fig. 3.41). Once the

(a)



(b)

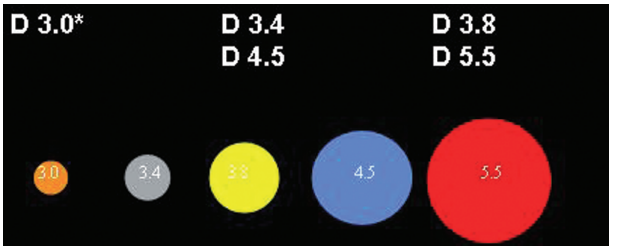


Figure 3.34 **(a)** The different diameters of the XiVe fixture. **(b)** The colour coding of the range of diameters

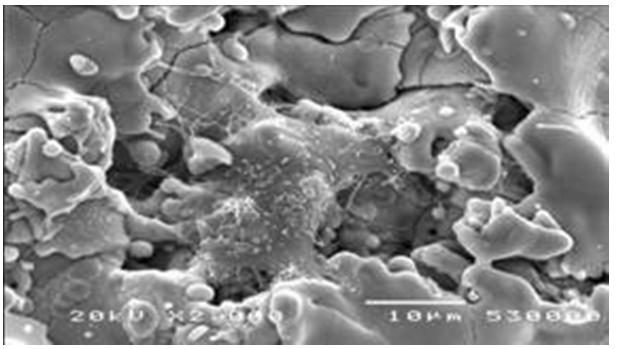


Figure 3.35 An electronmicrograph showing the titanium plasma-sprayed surface of the first range of fixtures

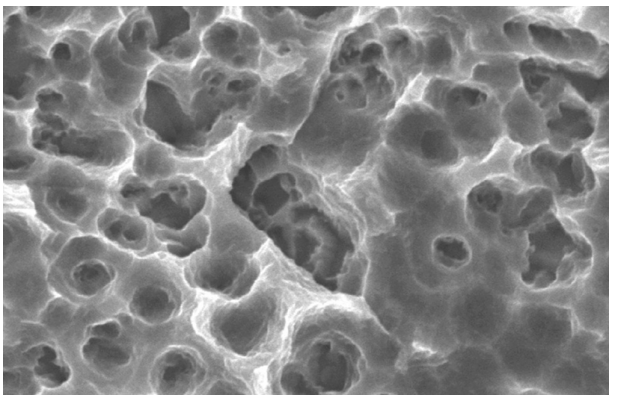


Figure 3.36 An electronmicrograph showing the new 'cell plus' acid-etched surface

Figure 3.37 The stepped drills used for Frialit 2 site preparation. Note the colour-coded band

abutment is connected to the fixture, the abutment screws should be tightened to 20 Ncm and the prosthetic screws to 10 Ncm using a manual torque driver (see Fig. 3.42).

The impression copings are fixture level copings and have a plastic positioning sleeve that can be used to convert the coping for a closed tray (see Figs 3.43a, b). This sleeve also helps with the relocation of the coping into the impression. All the prosthetic components are also colour coded. The final prosthesis is fitted with a silicone ring, which provides a hermetic seal for the abutment and fixture. This seal is thought to prevent bacterial contamination (see Fig. 3.44).

Instrumentation

For both the F2 and the XiVe systems the surgical and the prosthetics kits are compact and each is colour coded (see Figs 3.45a, b). This system has a number of additional dummy implants, positioning cylinders and depth markers that can be used during the preparation for checking the alignment.

The Ankylos System

The Ankylos® implant system was developed by Professor Dr G-H Nentwig and Dr W Moser in 1985 and was made available for universal use in 1987. Their aim was to reproduce as closely as possible the prosthetic characteristics of the natural tooth. The implant was designed with a structure such that optimal load transmission was obtained during functional loading (see Fig. 3.46). The unique feature of this system is the conical connection of the prosthesis into the implant.

Figure 3.38 **(a)** The twist drills used for XiVe. **(b)** The special cortical drill used as the last drill to flare the cortical aspect of the site. **(c)** The flare after the use of the cortical drill in site preparation of the XiVe fixture

Figure 3.39 The preformed MH abutments

Figure 3.40 The custom aurobase abutments. Note the colour-coded sleeves

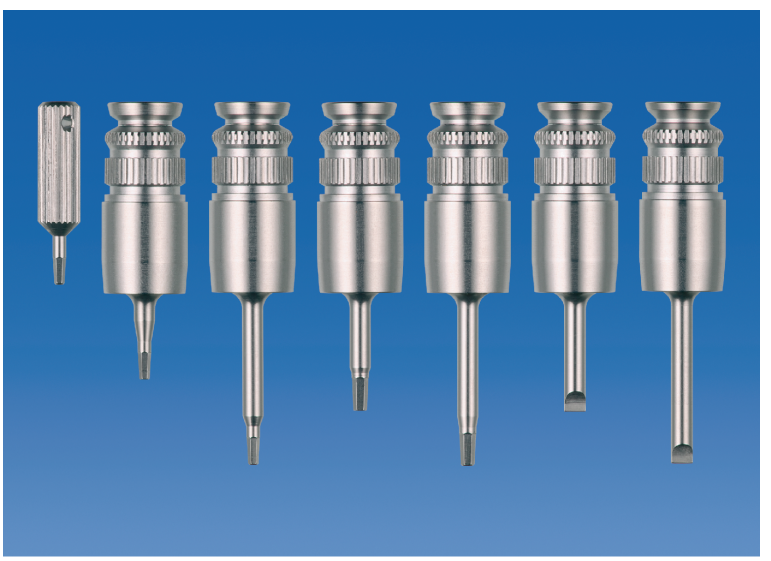


Figure 3.41 Range of screwdrivers used for the Frialit and XiVe systems

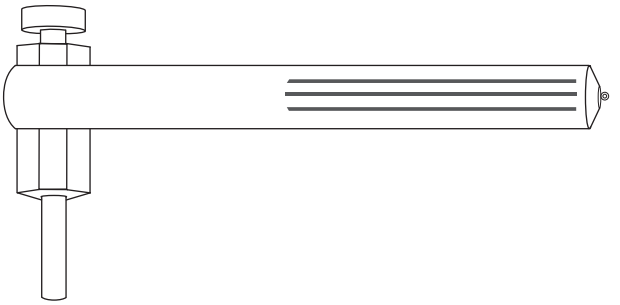
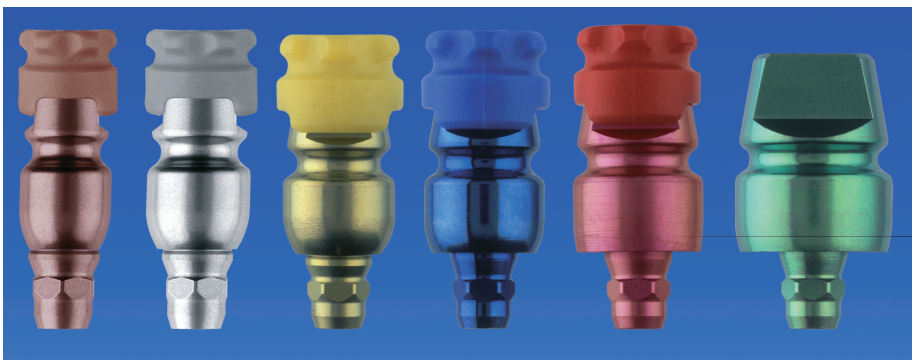


Figure 3.42 Manual torque driver

(a)



(b)

Figure 3.43 **(a)** Range of impression copings used at fixture level. Note the colour-coded plastic positioning sleeves. **(b)** Clinical picture showing the fixture level impression in situ with the colour-coded sleeve

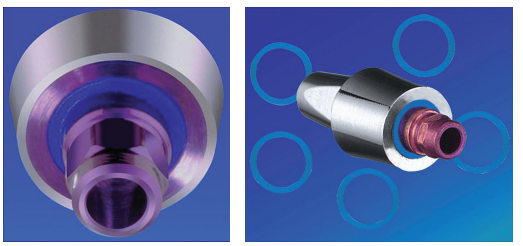
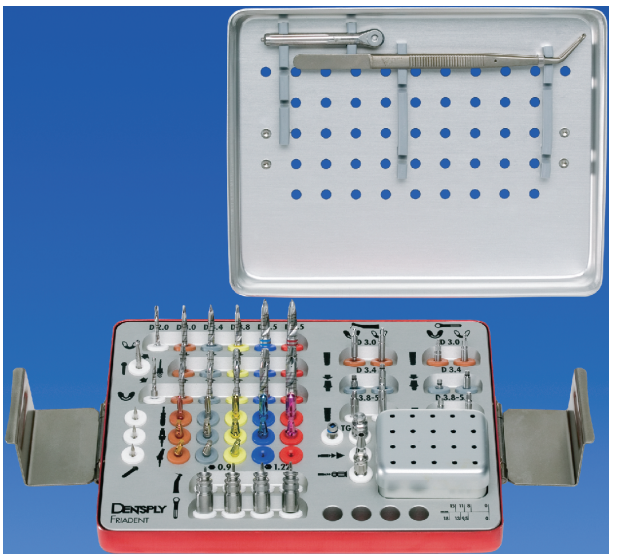


Figure 3.44 The blue silicone ring that is used to provide the hermetic seal at the fixture/abutment interface

(a)



(b)

Figure 3.45 **(a)** The F2 surgical kit. The simplicity of the kit is evident. **(b)** The XiVe surgical kit

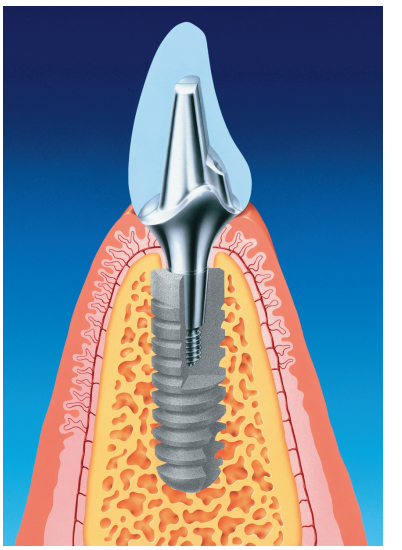


Figure 3.46 The unique design of the Ankylos system based on optimal load transmission during functional loading

This connection is thought to prevent microbial and mechanical irritation, thereby stabilizing the peri-implant hard and soft tissue. The system is primarily designed for intra-oral use.

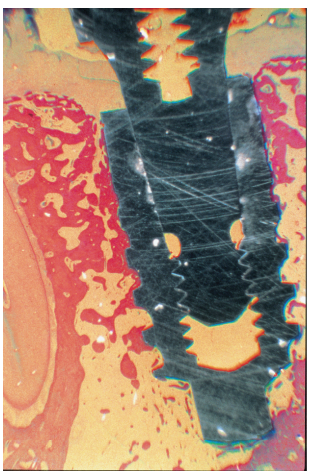
Implants

Ankylos® implants are made from non-coated pure titanium. The implant thread is specially designed and progressively increases in depth apically, thus imparting greater stability in the bone (see Figs 3.47a, b). The implant has a unique internal connection with a precision surface fit of the conical connector at the implant/abutment interface (Fig. 3.48a, b). The very precise fit of the conical surface eliminates the microgap and hence the associated risk of inflammation.

The fixtures are available in five different lengths (8, 9.5, 11, 14 and 17 mm) and three diameters (3.5, 4.5 and 5.5 mm). This system is also colour coded and hence allows easy recognition of the components that need to be used.

The fixture surface is the same acid-etched 'cell plus' surface used in the F2 and XiVe implants, thus reducing the integration period. Site preparation is undertaken in two stages: the machine-driven stage and manual preparation. The principles of drilling remain the same as with other systems, with adequate cooling and no overheating of the bone being prerequisites. The site is prepared with machine-driven instruments first and completed with two manual preparation steps using the conical reamer and the tap, both of which have non-cutting tips (see Fig. 3.49). The cover screw is pre-fitted onto the fixture and is only removed prior to threading in the abutment.

(a)



(b)

Figure 3.47 **(a)** The Ankylos implant. **(b)** The increased engagement of the apical threads into bone

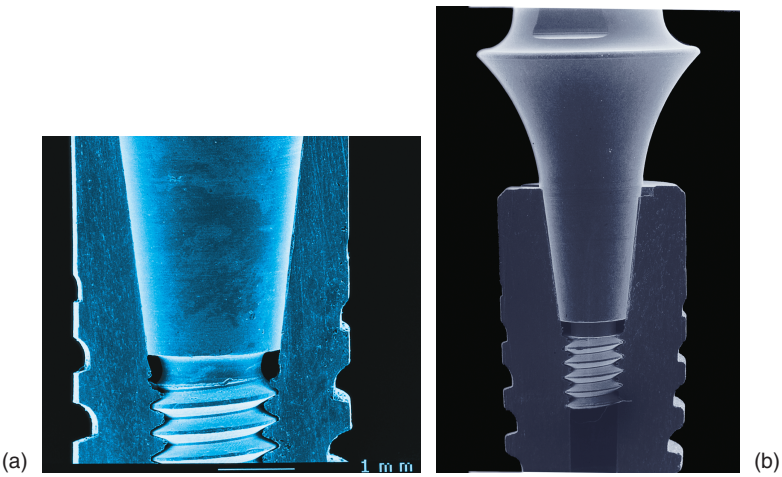


Figure 3.48 **(a, b)** The unique internal connection of the Ankylos system

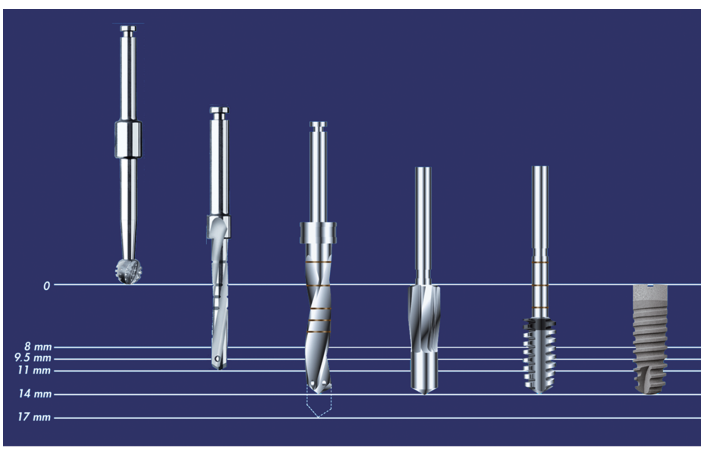


Figure 3.49 The drilling sequence. The last two drills, the conical reamer and the tap, are both hand-held and are the last step in site preparation prior to fixture placement

Prosthetic components

There are two main types of abutment: the balance base abutment and the syncone abutment. The latter is used when there is slight divergence of implants. In addition there are ball and socket abutments and also a syncone abutment for immediate loading. The geometry of the conical connector is identical for all implant diameters and abutment sizes, thus making the abutments freely interchangeable. The diameter of the abutment is determined by the diameter of the implant used. Fig. 3.50 shows the range of abutments available.

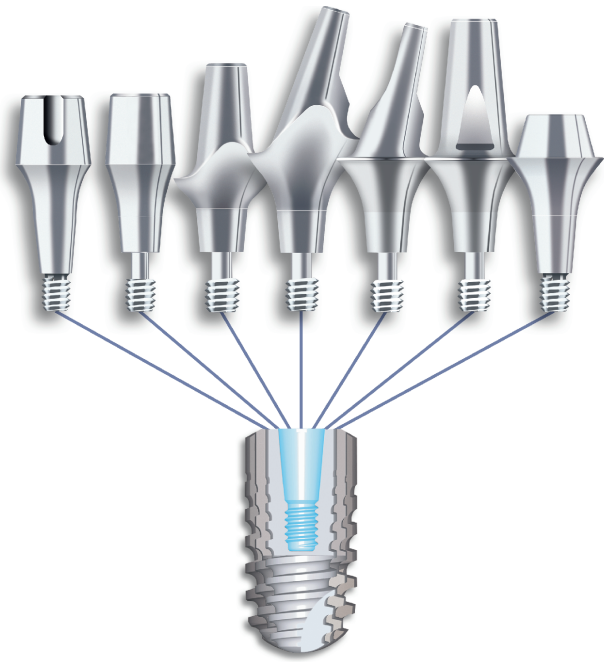


Figure 3.50 Range of abutments in the Ankylos implant system

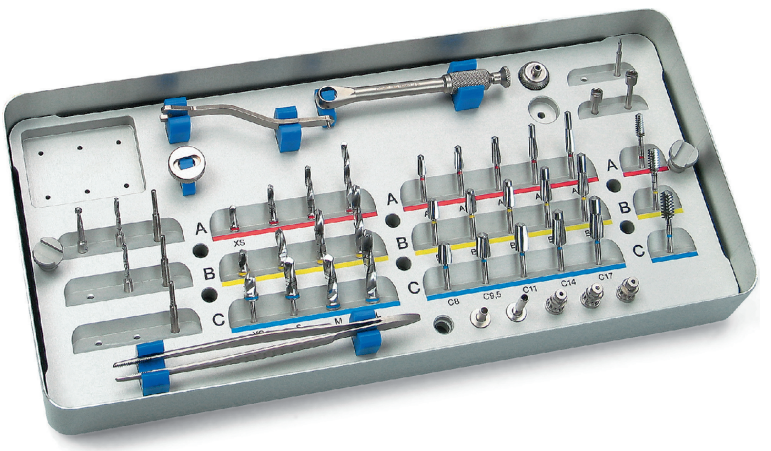


Figure 3.51 Ankylos surgical kit

Instrumentation

This system follows the same concepts as the XiVe surgical kit, with simplicity and colour coding being the key. Fig. 3.51 shows the surgical kit.

The 3i (Implant Innovations Inc.) System

The 3i (Implant Innovations Inc.) system is an American system and is owned by the Biomet Company. Originally marketed predominantly in the USA, the system has now gained acceptance throughout Europe, including the UK. The original design concepts were similar to those of the Brånemark System®, with some minor differences. The product line was marketed on simplicity and range. Although the natural taper(NT) implants are also marketed by the company, this chapter will only focus on the cylindrical implants. The design and concepts for the NT remain the same as the others, with the main difference being the use of tapered drills for site preparation.

Implants

Although originally the first implants were only available as external hex fixtures, these have been largely replaced by the use of the internal connection configuration called 'certain' implants. The range of fixtures available is vast and includes tapered implants (NT) and cylindrical implants. The certain implants are named as such due to the unique 'click' mechanism that is audible when the impression copings and abutments are seated onto the fixture. The system also offers expanded platform implants where the body of the implant has a smaller diameter with an expanded platform to facilitate an improved emergence profile for the restoration. This implant is designated the XP implant and is available in both external and internal configurations. Fig. 3.52 shows the range of fixtures available, and Fig. 3.53 shows the main differences between standard and XP fixtures.

The internal hex configuration has a click mechanism such that when the prosthetic components are seated an audible click is heard, confirming accurate seating of the component onto the implant (see Fig. 3.54) thus avoiding the need for taking verification radiographs. With the recent drive towards bone preservation, Biomet

Figure 3.52 Range of fixtures available with the 3i system: the standard certain, NT certain, external hex standard, external hex NT and XP

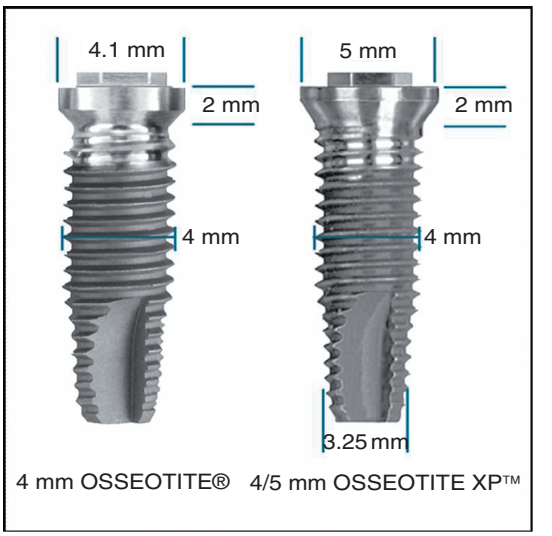


Figure 3.53 The difference between the standard fixture and the XP fixture

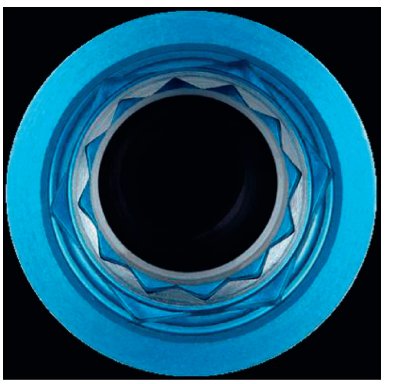


Figure 3.54 The internal connection of the 3i system

3i has introduced the 'prevail' implant, which is based on the philosophy of shifting the prosthetic microgap more medially on the implant platform, thus enabling bone preservation (see Fig. 3.55). Whilst this implant has been around for a while, the long-term outcome remains to be seen, although early reports appear promising. With all the different types of implants the apical cutting edge of the fixture is designed as an incremental cutting edge to facilitate self-tapping of the implant into the bone. The even distribution of the flutes ensures that maximum contact is maintained with the bone during the placement (see Fig. 3.56).

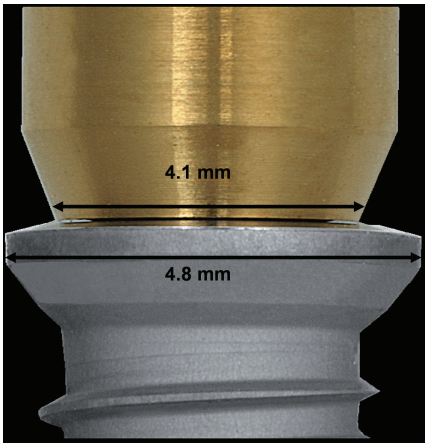


Figure 3.55 The prevail fixture with the microgap at the fixture abutment being shifted medially, thus preserving the bone

Figure 3.56 The incremental cutting edge design positioned apically on the hybrid osseotite surface

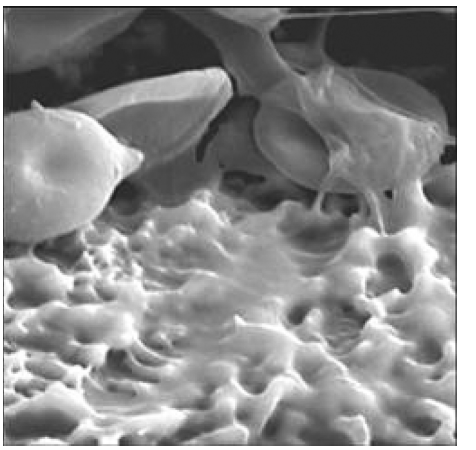


Figure 3.57 Electronmicrograph of the osseotite implant surface

The fixtures are available in six lengths (7, 8.5, 10, 11.5, 13 and 15 mm), with up to 20 mm available if needed, and four diameters (3.25 mm (micromini), 4.00 and 5.00 mm (standard) and 6 mm (wide)). With the external hex a diameter of 3.75 mm is also available. This does not include the XP platforms, which are available on the 4.00 and 5.00 mm fixtures as 4/5 and 5/6 mm.

The first implants were pure machined surfaces, but these have now been replaced by the osseotite surface. This is an acid-etched surface that enhances the rate of integration (see Fig. 3.57). The implants were originally marketed as a hybrid design with the coronal one-third of the implant being pure machined (see Fig. 3.56) to minimize bacterial colonization if the implant were to become exposed. However, this design is now being changed to a full osseotite surface where the etched surface reaches the top of the implant. The osseotite surface is currently being modified using nanotechnology to improve the integration rate and this implant is called the nanotite implant.

The drilling sequence follows the same stages as previously discussed with the other systems, with round and twist drills being used. However, when the XP implants are used an additional countersink is needed to flare the coronal aspect of the site to allow for the expanded platform. Fig. 3.58 shows the drilling sequence for the XP fixture. These implants do not need a mount and the driver for the certain implant has a unique configuration, as shown in Fig. 3.59. The driver has two markings, which enable the depth of insertion to be determined, for example subcrestal or at the crest.

Prosthetic components

The 3i System has a large family of preformed and custom abutments as well as the zirconium abutments. The gingival abutments are the most popular, with

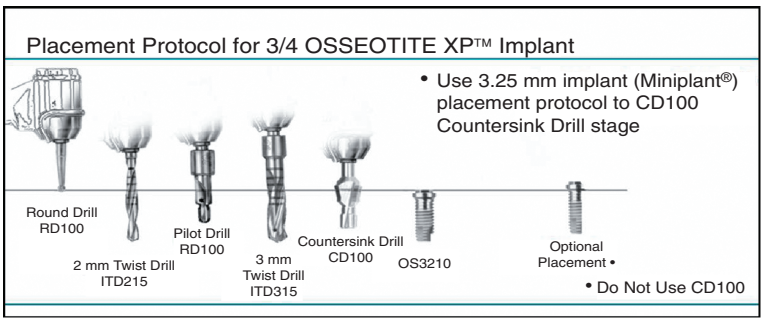


Figure 3.58 Drilling sequence for the XP fixture

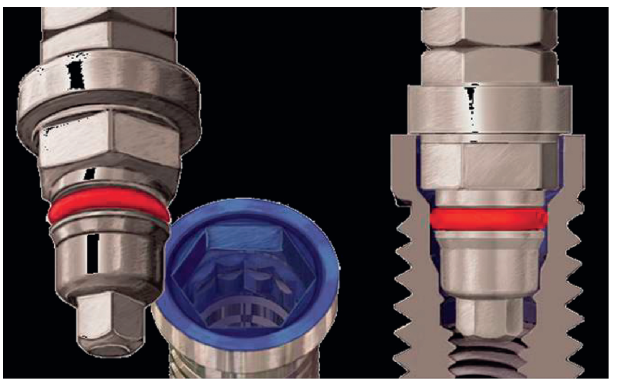


Figure 3.59 The fixture driver being inserted into the fixture for pick up prior to placement

the design of the abutments being the same for both the external and internal hex connections. Abutments are available for both cement and screw-retained prostheses. Figs 3.60a, b show the range of abutments available.

This system has a different healing abutment called the emergence profile abutment. It is designed to shape the gingival tissue following second-stage surgery to provide a shaped gingival collar prior to prosthetic replacement (see Fig. 3.61).

Instrumentation

The original surgical kits have now been replaced with simpler colour-coded kits, as shown in Fig. 3.62. The colour coding makes it easier for the assistant to follow thorough and match the drilling sequence to the implant. The prosthetic kit has a manual torque driver, and a smaller torque driver that only has a forward action with a 20 and 35 Ncm torque has also been introduced (see Figs 3.63a, b).

(a)

(b)

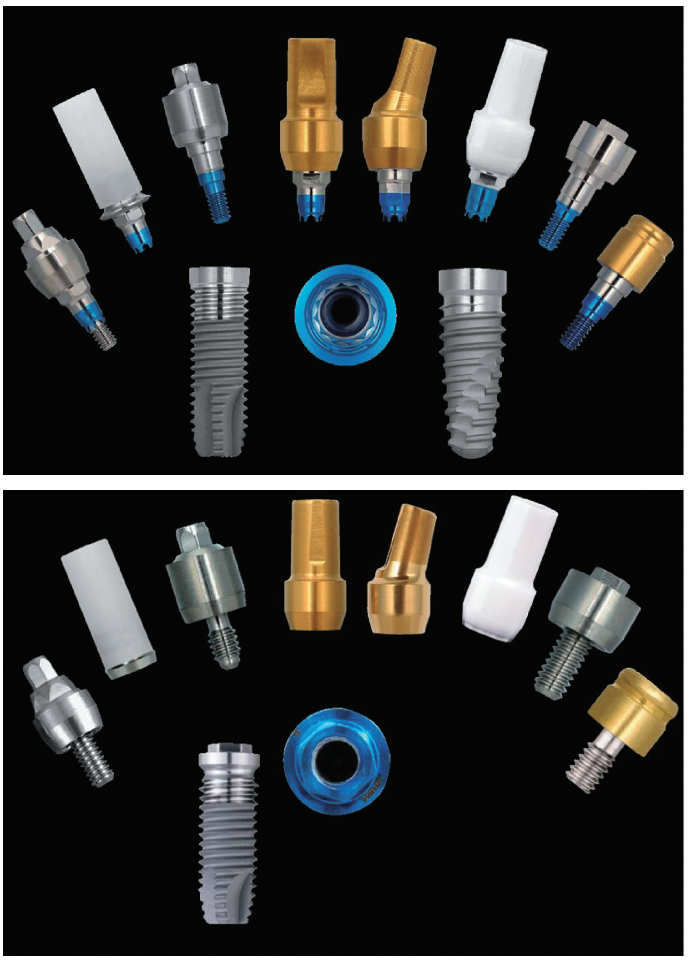


Figure 3.60 **(a)** The different abutments available for the internal connection. **(b)** The different abutments available for the external hex connection

Figure 3.61 Emergence profile healing abutments

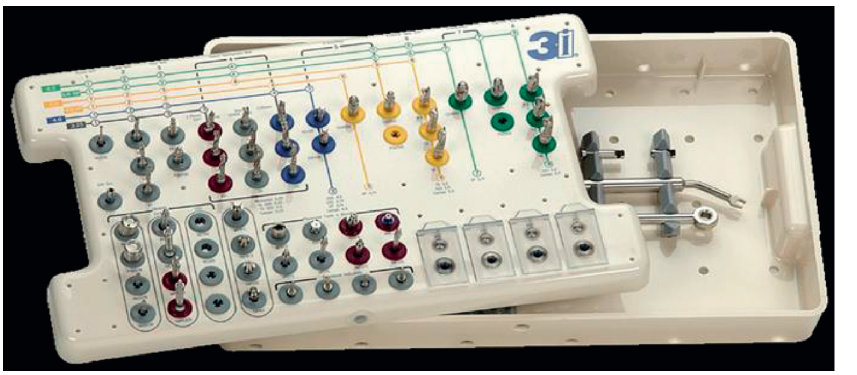
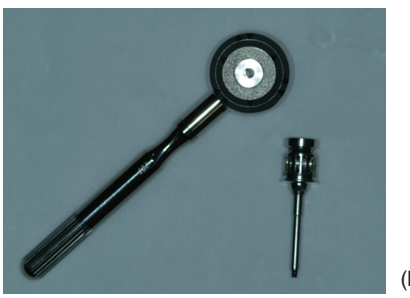


Figure 3.62 3i surgical kit

(a)



(b)

Figure 3.63 **(a)** The prosthetic kit and **(b)** the small manual torque driver

The Astra System

The Astra System was introduced to the market for clinical use in 1992. This system was based on the concepts postulated by Dr Stig Hansson and was one of the few systems at the time to have an internal conical joint compared to the external connection found in the majority of the systems. The unique features of this system were based on the concept that a microtextured surface to the top of the implant would help with bone preservation, the internal conical

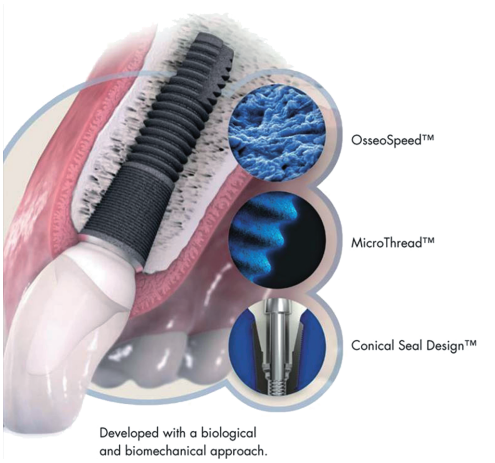


Figure 3.64 The design features of the Astra implant system

connection would help with more favourable load distribution, and microthreading to the top of the implant would help to improve load distribution but also retain crestal bone and the collar would help to reshape the connective gingival tissue. Hence this implant carried the four features of microtexturing to the top of the implant, internal cone, microthreading and the connective tissue contour (see Fig. 3.64).

Implants

The implants for this system are manufactured for use as a two-piece system. The implants have a unique design configuration with a roughened surface, microthread coronally and a conical connection of the implant to the abutment.

The original implant surfaces were created by means of a titanium oxide blasting procedure and the surface was called TiOblast. This surface now has been superseded by the osseospeed surface. This surface is a chemically active surface modified with fluoride to increase bone formation and enhance the bone to implant bond (see Figs 3.65a, b, c). The fixtures have a microthread coronally. These are minute threads that offer lower stress values and optimal stress distribution. This design is thought to promote bone preservation and maintain bone levels at the coronal aspect of the implant (see Figs 3.66a, b). The conical connection is called the conical seal design (see Figs 3.67a, b). This is a conical connection below the marginal bone level and it imparts load transfer deeper into the bone. The deeper connection is thought to reduce the peak stresses during function, thus enabling preservation of the marginal bone. Additionally the connection design seals off the interior of the implant from the surrounding tissues by moving the microgap away from the bone and increasing

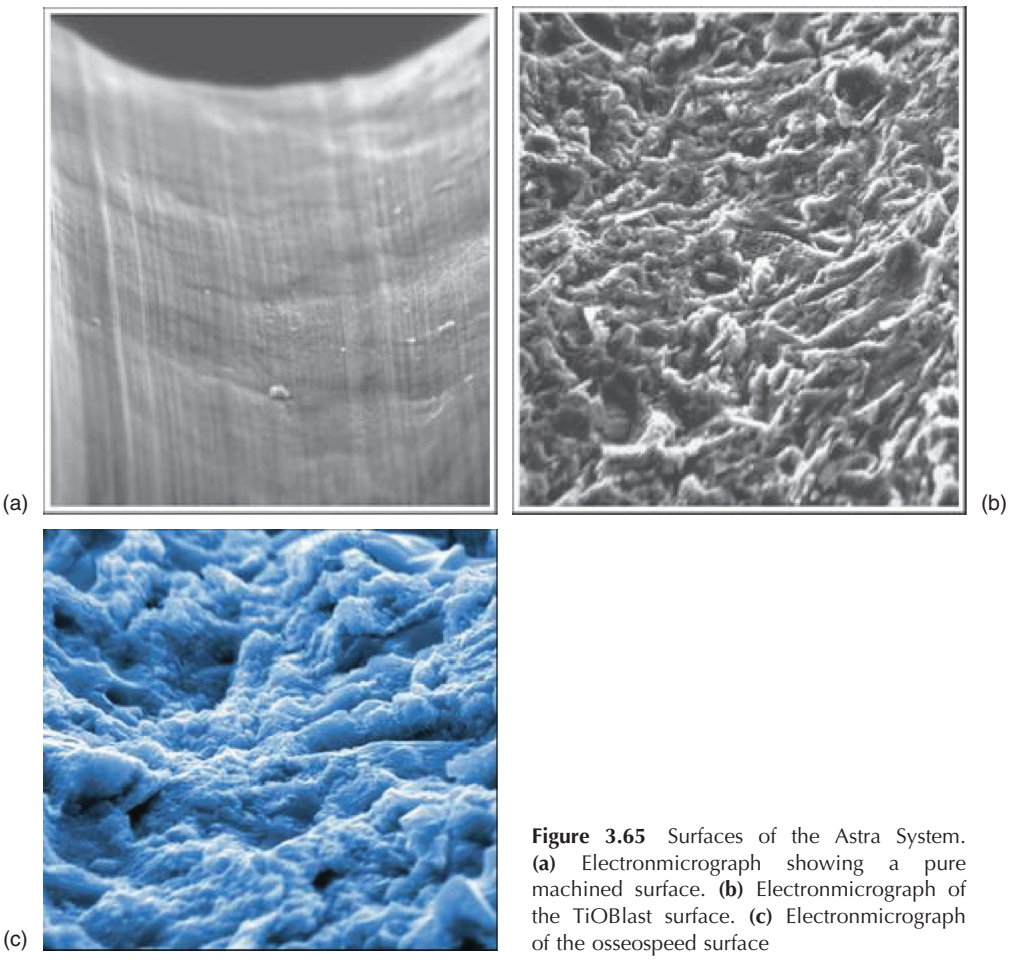


Figure 3.65 Surfaces of the Astra System. **(a)** Electronmicrograph showing a pure machined surface. **(b)** Electronmicrograph of the TiOBlast surface. **(c)** Electronmicrograph of the osseospeed surface

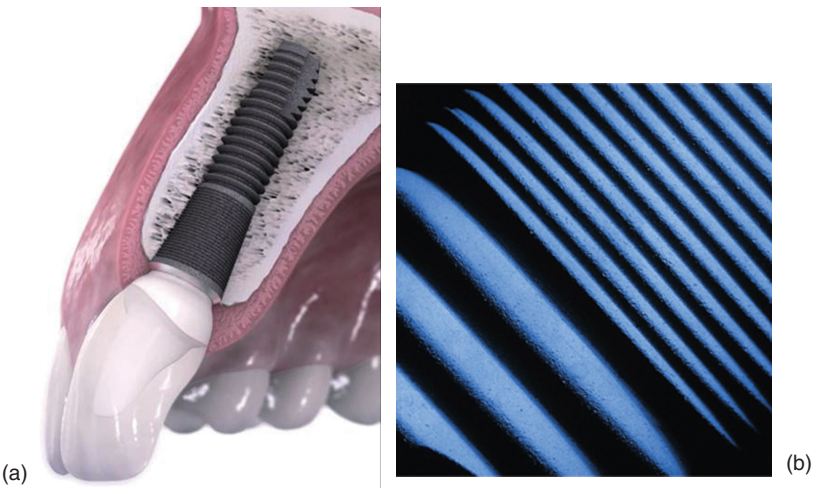


Figure 3.66 **(a)** The coronal microthread configurations of the Astra System. **(b)** The electronmicrograph shows the threads closely

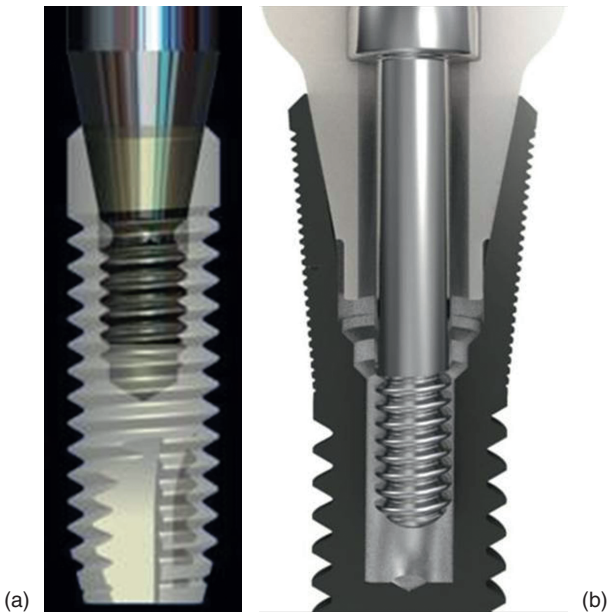


Figure 3.67 **(a, b)** The unique conical internal connection

the connective contour, thus reducing any microleakage and minimizing micromovements. The precision fit of the connection makes the fitting of the implant to the abutment a simple procedure.

The implants for this system were manufactured as a straight/conical design, with the coronal third as the conical shape. Today a new fixture called the 5.0 straight is also available. The entire fixture from the neck to the apex is 5.0 mm wide. This implant has been designed for use in sites where improved primary stability is needed and it has all the same design features as the conical implant (see Figs 3.68a, b).

The conical implants are available in two different diameters, 4.5 and 5.0 mm, and the straight implants are available in three diameters, 3.5, 4.0 and 5.0 mm (see Fig. 3.69). The 3.5 mm and 4.0 mm straight implants are available in lengths of 8, 9, 11, 13, 15, 17 and 19 mm, with the other diameters available in lengths of 9, 11, 13, 15, 17 and 19 mm (see Figs 3.70a, b).

The drilling sequence remains the same as for previous systems and follows a series of sequential steps with a range of drills being used (see Fig. 3.71). In this system the countersink is called the cortical drill and for the conical fixtures there is also a conical drill (see Fig. 3.72).

Prosthetic components

The prosthetic components for both types of implants remain the same as the connection is the same. The healing abutments come in various sizes (see

Figure 3.68 **(a)** The conical design of the Astra System. **(b)** The straight design compared to the conical design

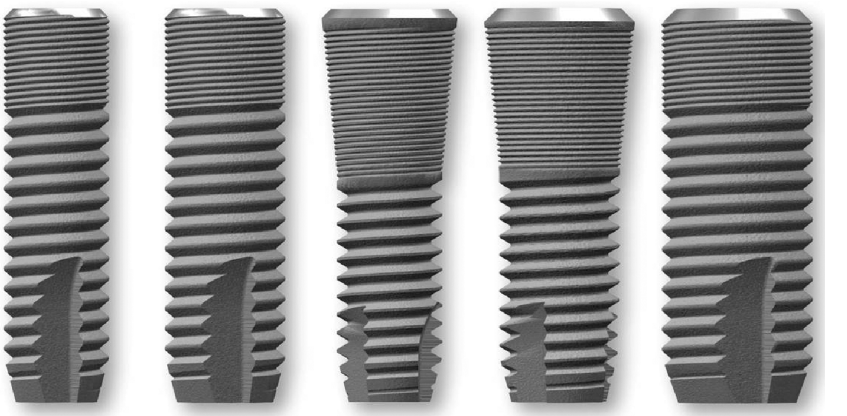


Figure 3.69 Different diameters of the system in the conical and straight fixtures

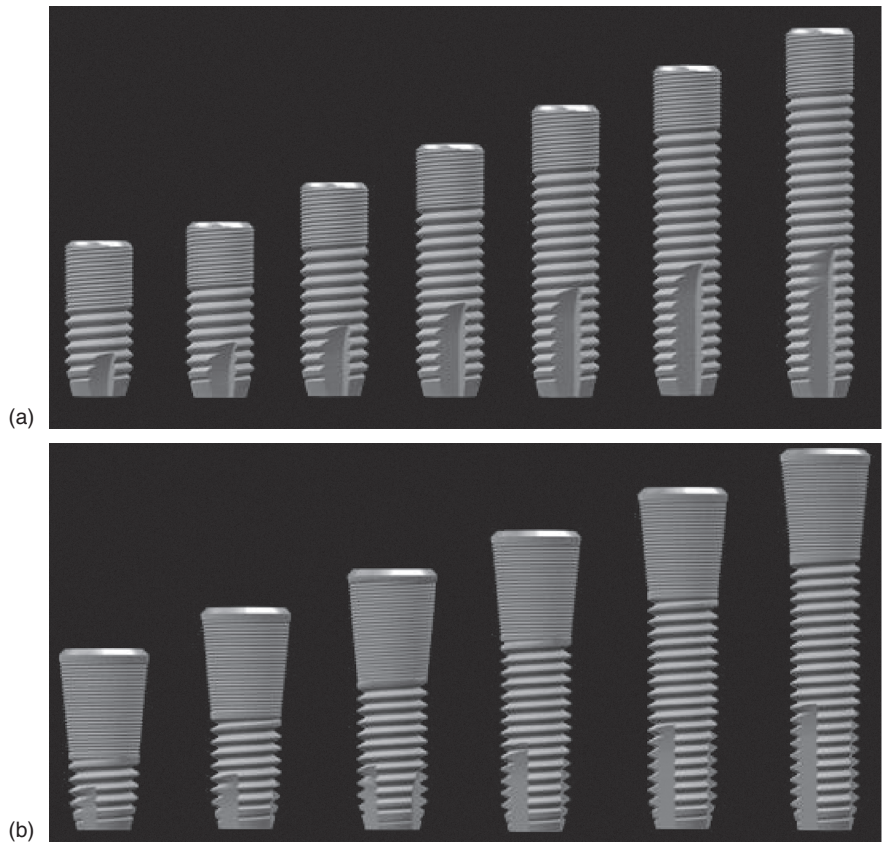


Figure 3.70 **(a, b)** The range of fixture lengths and diameters available. The 5.00 mm straight is also available up to 19 mm but this is not shown in this figure

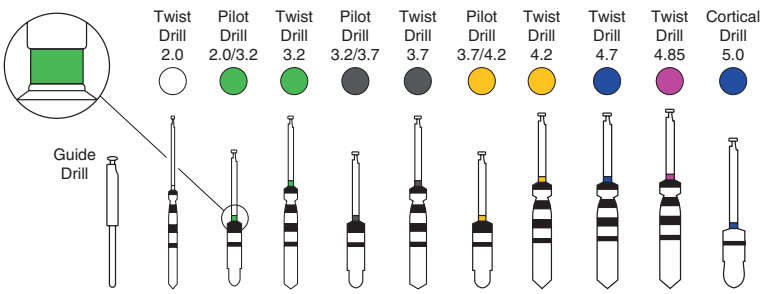


Figure 3.71 The range of drills. All the drills are colour coded. The last drill is the pilot drill. There is a cortical drill, which is the equivalent of the countersink

Figure 3.72 The conical drill used to prepare the conical flare for conical fixtures

Figure 3.73 Range of healing abutments

Fig. 3.73) and the conical shape apically allows for the contouring of the gingival tissues during second-stage healing. The main difference with this system is that when the abutment is connected to the implant, a unique contour is created, as shown in Fig. 3.74, which allows for increased soft tissue contact both in height and volume, and closer integration into the transmucosal part of the implant, thereby sealing off and protecting the marginal bone. As with other systems there are both preformed or custom abutments available. Angled abutments are also available. As with the other systems, there is also a zirconium abutment available. Fig. 3.75 shows the range of prosthetic abutments available. This system also has a direct abutment.

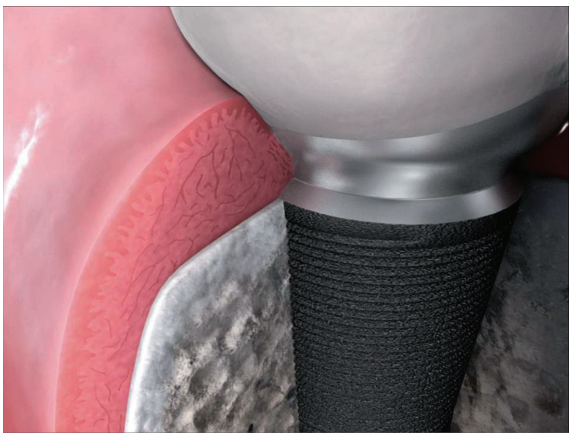


Figure 3.74 The connective tissue contour when the abutment is connected to the implant

Instrumentation

The surgical tray is compact with clear marking showing the assistant the drilling sequence and components needed (see Fig. 3.76). The prosthetic kit is compact and has a manual torque driver (see Figs 3.77 a, b).

Choice of implant system

The choice of system will usually be determined by the clinician and will normally be driven by the case mix and type of patients attending the clinic for tooth replacement with dental implants. The patient's need is determined by clinical assessment and the choice of system will be dependant on the needs of the patient groups seen and also the clinician's skills and familiarity with a specific system. Over and above the need for evidence-based outcomes, familiarity with the system selected will remain the key factor in ensuring predictable outcomes at a local level. The majority of the systems on the market today have developed products offering a wide range of choices both for fixture placement and restoration, but the following parameters should be taken into account when choosing a system:

- a proven track record of success
- should have strong implants and ideally must be made of commercially pure titanium or a titanium alloy that does not compromise osseointegration
- should have versatile prosthetic products and offer the option of being used as a one-stage or a two-stage system
- should be user friendly and easy to follow and learn.

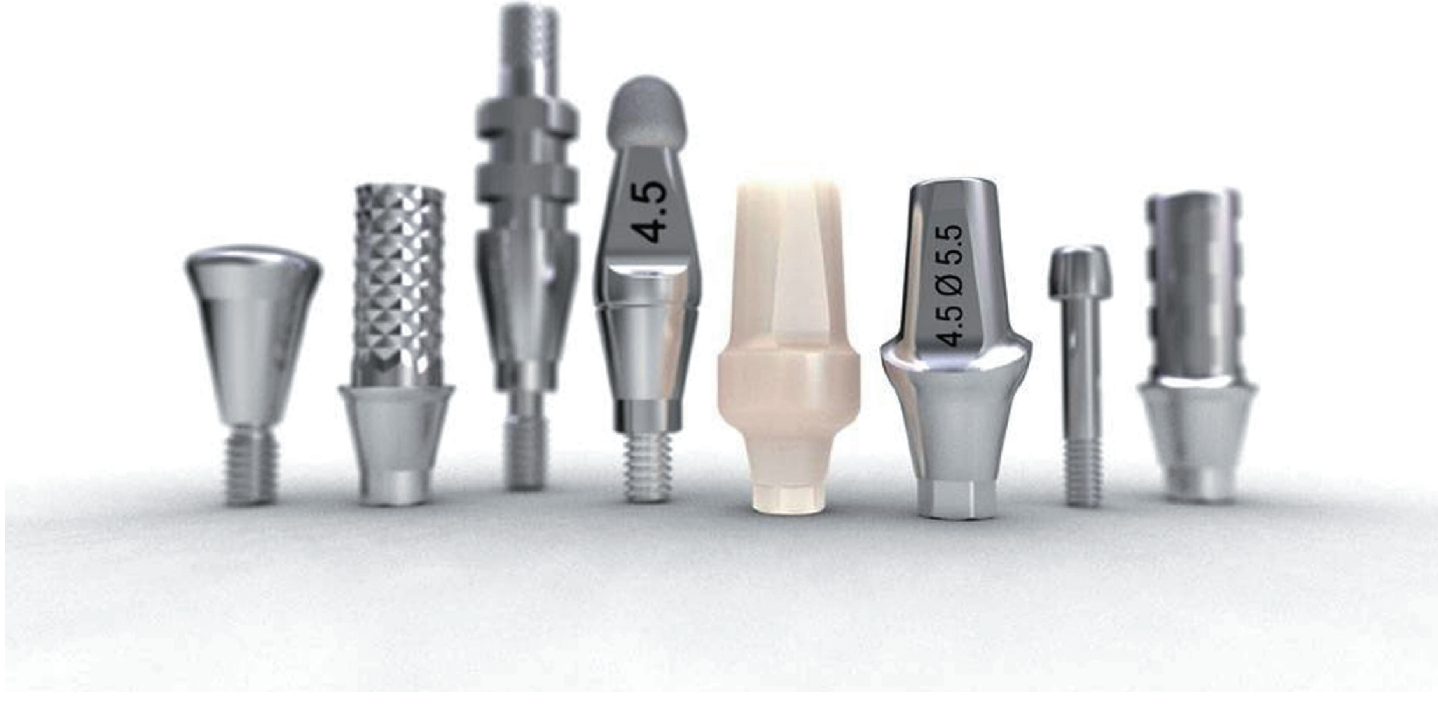
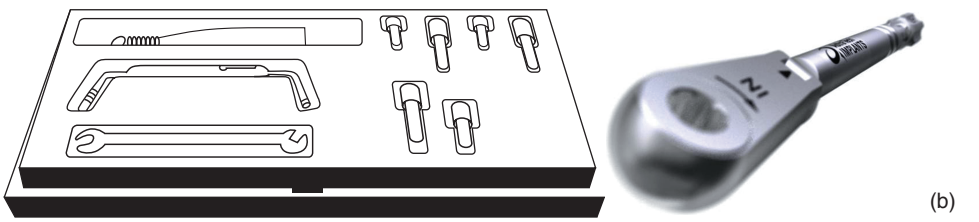


Figure 3.75 Range of abutments available for the Astra implant system

Figure 3.76 Surgical kit for the Astra System

(a)



(b)

Figure 3.77 **(a)** Prosthetic kit with **(b)** the manual torque driver

Irrespective of the system used, it is important to be familiar with the product range and components to ensure that the procedure, once started, goes smoothly. Most companies will offer training courses for nurses and clinicians as well as chair-side support as and when necessary. The need for regular updates is also crucial to ensure that product knowledge and changes in the product range are kept updated, especially as all the companies regularly update existing products or introduce new ranges within their product line. This is especially important for dental nurses, who will be expected to set the procedure up for all the three stages: surgical, prosthetic and follow-up. To ensure that the products are maintained and serviced, on completion of the surgical procedure the components used during surgery, especially the drills, must be carefully disinfected and decontaminated. This is a stepwise procedure that is covered in Chapter 8. The onus for this falls onto the nurse and hence it is important that the nurse's product

knowledge and decontamination protocol are up to date. Additionally, the nurse will need to record and log the number of uses of each drill for the multiple-use drills and reorder these as needed.

Conclusion

This chapter details the different implant systems. However, it is clear that the concept and methodology of all the systems remains the same and each of the companies have now resorted to simplifying their equipment and kits with colour coding. Most systems adopt colour coding to simplify the sequence of procedures, thus making the procedure much more user friendly. The nurse's role in the field of implantology cannot be underestimated. Nurses need to be familiar with systems and products to ensure that the correct procedures are followed in relation to site preparation and prosthetic connection as well as disinfection, and that the correct products are available on the day of treatment. Invariably the nurse will have to deal with the companies in ordering products and components for the treatment as well as when there is a problem and the only way this can be achieved is by ensuring that their product knowledge is up to date.

8 The dental nurse's role in implantology

It is said that for implants to be a success all of the dental team need to be trained (Hobkirk et al. 2003). There are various providers of training for the dental team in this area, including manufacturers of implant systems, dental hospitals and private companies. Training for dental nurses usually comprises 1- or 2-day courses, either in conjunction with clinicians or specifically for dental nurses. Whatever course you choose, remember that as part of the dental team the dental nurse's role is vital to the success of implant procedures.

This chapter will endeavour to give guidelines on the role of the dental nurse during an implant restoration, from a simple single tooth restoration to a full-mouth reconstruction.

The role of the dental nurse in implantology can be broken down into the following stages:

- the initial visit
- the planning stage
- the preparation stage
- the surgery stage
- the post-surgical procedure (postoperative care)
- the second-stage surgery (if part of the treatment plan)
- the abutment fit and the impression stage
- the fit stage
- the review stage.

The initial visit

When patients attend the dental surgery, the suggestion of implants could simply be an outcome of a routine dental check-up, as a treatment option. Some patients may already have implants in mind as it is a treatment option that patients are becoming more familiar with. Whatever the reason for a patient having implant treatment, the dental nurse's role at this initial visit will be to:

- ensure the medical history is taken
- ensure the dental chart is correct, showing the teeth present, the restorative treatment required, the gingival condition and previous dental treatment
- develop radiographs – full-mouth periapicals to dentopantomograms (to assess the feasibility of implant placement)
- mix alginate for study models (for treatment planning to take place)
- assist with the face bow (so the study models can be articulated)
- provide the relevant literature on implant treatment
- support and reassure the patient during the visit
- arrange for the patient's next visit (allowing time for the clinician to plan the treatment).

Instruments

- Mouth mirror
- Straight probe no 6
- CPITN probe
- Periodontal pocket measuring probe, for example UNC15
- College tweezers
- Furcation probe, for example Nabers
- Gauze and cotton wool rolls
- Electric pulp tester
- Personal protection equipment for the patient, clinician and dental nurse, for example safety glasses, bib, mouthwash.

The planning stage

Before the initial visit the clinician will have looked at the evidence and made a preliminary treatment plan. At this visit the treatment plan and what could be achieved will be discussed with the patient.

It is important to listen to the proposed treatment plan as it will allow you to clarify the proposal should the patient want additional information. Remember, part of the dental nurse's role is to provide support and act as a chaperone to the clinician.

At this visit, a diagnostic wax-up of the missing teeth may be necessary, allowing the patient to see the long-term outcome of the treatment. Further special radiographs may also be required, as described in Chapter 6. These radiographs assist the clinician in deciding how good the surrounding alveolar bone is. These radiographs are specialized therefore an appointment for this may have to be arranged. The diagnostic wax-up may also be used to construct a surgical stent.

During this visit the clinician may take an impression for a surgical stent. 'Surgical stents are used to assist in the placement of the dental implant' (Hobkirk et al. 2003).

It may be the responsibility of the dental nurse to arrange for the relevant components to be available. There must always be a stock of the required length of implants. Implant manufacturers have different policies on ordering. For example, some companies allow items purchased to be returned if not required. Both the dental nurse and the clinician need to discuss how much stock is acceptable. Remember, implant components are expensive. When a clinician has decided on what is needed, ensure that these components and disposables are available (see prepping the surgery).

Edentulous patients may require dentures to be made before implant surgery takes place. The role of the dental nurse is the same as when providing a patient with a new denture. Some patients may have a single tooth extracted and a partial denture fitted before the surgery takes place, whereas other patients may have the tooth extracted on the day of surgery and an implant fitted straight away.

Simple replacement of a single tooth

Preoperative preparation for the surgical procedure

Depending on the system used, the drill kits can either be single or multiple use. In the former, the drills are discarded after use. Multiple use drills will need the number of used episodes to be documented. Once the recommended use has been reached, these are discarded. Remember to always have a spare set available.

Implant components – fixtures

It is ideal to have a selection of fixtures either side of the size planned as clinicians can change their minds once the procedure has begun. As previously discussed, many implant manufacturers allow an exchange policy because of the high cost of components. Discuss with the manufacturer the policy that applies to the system you use, not forgetting that the corresponding healing abutments may need to be ordered if necessary.

Order a **surgical drape kit**, which comes in various styles but usually contains:

- sterile gowns ×3
- theatre caps ×3

- patient drape
- sterile bench and bracket table covers
- sterile bag for the drill equipment
- gauze
- aspiration tip and tube
- sterile light handle covers
- sterile aspiration tubing.

If you do not order a designed drape kit, items can be purchased separately. Ensure you have in stock:

- sterile gloves ×3
- face mask/visor
- patient safety glasses (which should be soaked in antiseptic)
- sterile surgical blades usually no. 11/12/15
- vicyrl sutures
- bone trap
- saline bag – 500 ml IV
- local anaesthetic
- needle
- chlorhexidene scrub solution
- needle guard
- topical anaesthetic
- chlorhexidene.

Ensure that the surgical stent has been returned from the laboratory. Soak the stent in dilute hydrochloric acid for 10 minutes, rinse and place in a bowl of chlorhexidine mouthwash.

Preparation for the surgical procedure – surgical placement of the implant fixture

When preparing a dental surgery for implant placement, it is said that asepsis can hold the key to the long-term success of an implant, 'The importance of asepsis in the long-term success of implant procedures cannot be over emphasized' (Garg et al., 2005). It is therefore important that the definitions of asepsis and antisepsis are understood.

Asepsis is the absence of living pathogenic organisms. The procedure used to reduce the risk of bacterial contamination involves:

- the use of sterile instruments
- the use of the no-glove touch technique.

Antisepsis is the removal of transient micro-organisms from the skin and a reduction in the resident flora.

When preparing the dental surgery using asepsis technique ideally there should be two dental nurses, each with a different role. Dental nurse 1 takes the role

of the **circulatory** or **non sterile** dental nurse. Dental nurse 2 takes the role of the **sterile** or **scrub** dental nurse. Each dental nurse has a specific duty. Sometimes one dental nurse has to perform both roles. With organization this can be achieved.

General rules of asepsis

- The circulatory (non-sterile) dental nurse should never reach over the sterile area.
- The circulatory (non-sterile) dental nurse and objects should remain at least 30 cm (1 ft) away form all sterile areas.
- The scrub (sterile) dental nurse should only handle sterile items.
- The scrub (sterile) dental nurse is considered sterile on the front only, from the shoulders to the waist.
- If there is any doubt about the sterility of an object or area, it is considered to be non sterile.
- All items in the sterile field must be sterilized according to approved methods (Central Sterile Supply Department) or through a sterilizer with a vacuum drying cycle.

The role of the circulatory dental nurse

- Remove all unnecessary items (such as plants, cups and personal items) from the surgery. Anything not being used for the procedure should be removed.
- Wipe down all horizontal surfaces with an alcohol-based disinfectant cloth, including lights, equipment stands and chair.
- Ideally the walls of the surgery should be wiped with an antiseptic up to 1.21 m (48 in) from the floor.
- The floor should also be cleaned. This can be arranged by ensuring the cleaner has thoroughly mopped and disinfected the floor area prior to the surgical session.
- Gather all necessary supplies.

Pre-operative preparation

Gather all essential items. Always use a checklist to ensure all items are present:

- sterile instruments (surgical kit)
- local anesthetic tray – dental mirror, straight probe, periodontal probe college tweezers, local anaesthetic syringe, needle, cartridges of local anesthetic, topical anaesthetic paste, re-sheathing device, chlorhexidine mouthwash and timer
- materials – additional local anaesthetic cartridges, saline, chlorhexidine mouthwash
- disposables – sterile gowns, sterile needles, sterile scalpel blades, etc.

- implant machinery
- components – drills and fixtures
- a portable suction unit (preferred but not essential)
- a radiographic viewer with the appropriate radiographs displayed
- graft materials.

Basic surgical instruments (all items prepared/autoclaved)

A set of instruments should ideally be purchased for basic surgical procedures Remember, instruments are only deemed sterilized when bagged, and if the sterilizer has a drying vacuum cycle and instruments come out dry on completion of the process. If the sterilizer does not have a drying vacuum cycle and the instruments come out wet, you will be unable to use the bagged system. The instruments should be laid on a tray without touching, placed in the cycle, allowed to cool and taken from the non-vacuumed sterilizer straight to a sterile surface.

The basic instruments required are:

- mirror
- probe no. 6
- college tweezers
- periodontal pocket measuring probe
- scalpel ×2
- periosteal elevator
- tissue forceps
- suture scissors
- needle holders
- retractor
- syringe
- bone ronguers
- artery forceps
- curettes.

Implant equipment

- Drilling unit and motor assembled with a handpiece.
- Disposable hose set for irrigation equipment with a saline infusion bag (500 ml).
- Implant components – as stated before it is ideal to have a selection of fixtures either side of the size planned.
- Healing abutments or similar if the procedure is single stage.
- Bone trap.
- The surgical stent, which should be soaked in chlorhexidine (1 h minimum).
- Additional equipment.
- Special kits for grafting.

Surgical scrub

Step 1
Remove all jewellery on hands and wrists.
Step 2
Adjust the water to a warm temperature and wet hands and forearms thoroughly.
Step 3
Clean under each fingernail with a stick or brush. It is important for all surgical staff to keep their fingernails short.
Step 4
Holding hands up above the level of elbow, apply the antiseptic. Using a circular motion, begin at the fingertips of one hand and lather and wash between the fingers, continuing from fingertip to elbow. Repeat this for the second hand and arm. Continue washing in this way for 3–5 minutes.
Step 5
Rinse each arm separately, fingertips first, holding hands above level of elbow.
Step 6
Using a sterile towel, dry arms – from fingertips to elbow – using a different side of the towel on each arm.
Step 7
Keep hands above the level of waist and do not touch anything before putting on sterile surgical gloves.

Gowning and gloving

- After scrubbing the hands the sterile dental nurse should put on the sterile gloves and gown.
- The sterile dental nurse will set up the sterile work area with the aid of the non-sterile circulating dental nurse.
- All personnel should wear hats and masks whilst setting up the surgery.

Putting on sterile gown and gloves

- Ask the circulating dental nurse to open the packages.
- After scrubbing, the sterile dental nurse should dry hands from the fingers to the elbows using sterile towels.
- Packages such as bone traps, grafting materials and implant fixtures should only be opened during the surgery when the clinician is ready for them.

Gowning

The scrub dental nurse should take hold of the gown, which is folded with the inside facing outwards, placing hands in the sleeves and opening the gown.

Figs 8.1a, b, c and d show the gowning technique.

(a)

(b)

Figure 8.1 **(a–d)** The gowning technique

(c)

(d)

Figure 8.1 *Continued*

As the scrub dental nurse places the arms in the sleeves, the circulating dental nurse should take hold of the inside of the gown from behind, pull it on and lace the ties at the back. The final tie of the gowning is completed after the gloving procedure.

Gloving

- The circulating dental nurse opens the package containing gloves.
- Taking the inner package, the sterile dental nurse opens it and grasps the folded opening of one glove and places the other hand on it. The fold should not be unrolled.

Figs 8.2a and b show the gloving technique.

- With the gloved hand the scrub dental nurse grasps the fold of the other glove and places it on the hand without touching the outside of either glove.
- The scrub dental nurse should then roll the folded edges of the gloves back over the sleeve opening of the gown.

Gowning

- The scrub dental nurse may now wrap the belt of the gown around and tie it with the assistance of the circulating dental nurse.
- The scrub dental nurse takes the tag and hands the white part to the circulating dental nurse.
- The scrub dental nurse then rotates and pulls away from the circulating dental nurse until the belt can be tied.

Preparing the surgery

- The surgical drape kit is placed on the bracket table and should be opened by the circulating dental nurse so that the outer drape completely covers the bracket table.
- The circulating dental nurse then opens the bags containing the sterile equipment. The scrub dental nurse places the instruments on the bracket table and organizes the instrument drapes.

Bracket table cover

- The bracket table is covered completely
- The scrub dental nurse opens the cover, places hands inside and lifts the cover over the bracket table.
- The circulating dental nurse takes the corners and pulls them over the bracket table.

(a)

(b)

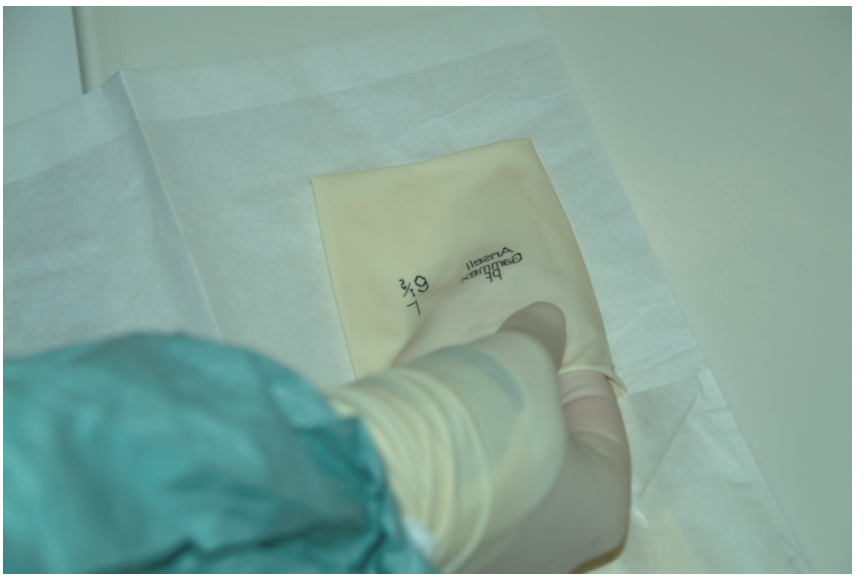


Figure 8.2 **(a, b)** The gloving technique

The drilling equipment and motors

- Both the controller set and drilling equipment should be covered with sterile drapes. The drilling equipment can be placed in a sterile bag provided in the drape kit or covered with a sterile sheet.
- The drilling equipment should be checked, activated and left on stand-by.
- Cables, dental motors and the irrigation bag are connected by the circulating dental nurse and covered with relevant sterile tubing covers.

- The scrub dental nurse places a cover over the cables and dental motor. The circulator dental nurse pulls down the tubing, only touching the fold.

Aspiration system

Connect the aspiration system using suction tubing provided (ideally two aspirator tips should be available so both dental nurses can aspirate during the procedure):

- one aspirator tip to aspirate any saliva and saline from the oral cavity and in particular the back of the throat.
- one aspirator tip to connect to a bone trap as the clinician may wish to collect bone during the site preparation to use for augmentation later. Remember, aspirating with a bone trap means the bone collected should not be contaminated with saliva and hence must not be used to aspirate saliva.

Completion of surgery preparation

- Make sure all areas are covered with sterile drapes until needed.
- Don't forget to prepare a local tray and basic instruments for when the patient first sits in the chair, ideally this should be done elsewhere.
- If the dentist has a surgical stent, bathe the stent in chlorhexidene.

The dental nurse's role during surgery

Preoperative care of the patient

Usually the sterile dental nurse begins prepping the patient whilst the circulatory dental nurse aids the clinician with gowning, and then prepares to become the aspiration dental nurse when the clinician begins the procedure. The sterile dental nurse will become the component nurse during the surgical procedure.

Duties of the circulatory dental nurse:

- Meet and greet the patient.
- Ensure that the patient has eaten before the treatment, and if not then give a glucose drink.
- Check any changes in medical history.
- Make sure the clinician goes through the treatment plan and the patient knows what is going to happen.
- Make sure the consent form is signed.
- When the patient sits in the chair ask the patient to rinse with chlorhexidine mouthwash for 1 minute (use a timer so the patient completes the 1 minute rinse).
- Before the local anaesthetic is given place the theatre cap on the patient.
- Lipstick should be removed.

- Patients may be given antibiotic cover of 3 g of amoxicillin or 600 mg of clindamycin, depending on the clinician and the patient's previous medical history.

Duties of the sterile nurse

- When the procedure is about to begin and the patient is draped, wipe the soft tissues with chlorhexidene, stroking away from the oral cavity, using sterile gauze and a pair of artery forceps.

The surgical procedure

The aspiration dental nurse stays on site, keeping the surgical field clear from blood. This dental nurse may also retract the tissues and irrigate the drill if the system does not have internal irrigation.

The component dental nurse will pass dental instruments and load the handpiece with the relevant drills and components. This is where specialist implant training for the relevant system will aid support and knowledge.

As a tip to keep on track with the procedure, always tell the clinician what drill or component you are passing to them. This prevents confusion. Most companies also have simple diagrams of drill sequences that you can laminate and display on the wall. Remember to place all drills back into relevant place so they do not get lost. Remember to rinse the bur in saline as bone can also be collected in this way.

When the clinician has requested the implant, the circulatory nurse opens the packaging, and drops the 'sterile' internal package onto the drape. The component dental nurse will then pick the implant fixture without touching it. Any contact with the implant surface is likely to cause loss of osseointegration.

During the drilling of the bone the speed of the motor is usually set between 800–1000 rpm depending on the system. The implant insertion/placement torque is usually at 25–35 NCM, depending on the bone quality. Therefore remember to adjust the speed of the motor as the implants are being placed.

The aspirating dental nurse must allow the blood to flow as the clinician places the implant; it is always tempting to clear the areas to improve visibility. At this stage refrain from doing so as it allows the socket to have a good supply of blood for ossteointegration to take place.

Once the implant is in place the component dental nurse must make sure that the information on the packaging of the implant is recorded, both in the patient's notes and on a record card for future reference. Implant manufacturers will require as much information as possible regarding the implant placed should it fail.

Following placement of the implant, depending on the technique used, a cover screw will be put in place and the site sutured or a healing abutment put in place. Whatever the procedure, sutures need to be provided and following closure postoperative instruction should be given by the aspirating dental nurse whilst

the component dental nurse begins the procedure of clearing away. It is important that the dental nurse remembers to clean the drills immedialely after use.

Postoperative care of the patient

Postoperative advice should be given to the patient by the dental nurse:

- Warn the patient there may be swelling and bruising.
- Use a pressure pack or ice pack to reduce the swelling.
- Pain control – an analgesic may be prescribed; patients are advised to take what they usually take for a headache.
- If a patient is prescribed antibiotics they should complete the course.
- Some patients are prescribed nasal drops, especially if they have had implants placed close to the sinuses. The nasal drops will dry the nose so patients will not have to blow their noses.
- Haemostasis – sterile gauze is provided should bleeding occur.
- Rinsing – saline solution or chlorhexidine mouthwash should be recommended.
- Instructions on keeping the area clean are given.
- An appointment must be given for suture removal.
- Give the patient a contact telephone number for emergencies.
- Some patients may not be allowed to wear their denture at first because of the incision placement.
- If a patient is allowed to wear their denture it should be kept in overnight for the first night.

Cleaning and sterilizing of instruments

Cleaning procedure:

- Sharps should be removed and disposed of (by clinician).
- Surgical instruments should be placed in an ultrasonic bath with general purpose cleaner for 12 minutes, rinsed, scrubbed and dried ready for sterilization.
- Depending on single use or multiple use, the drills may need frequent changing depending on bone density.
- Make a note of the drills discarded so they can be replaced and reordered.
- The drills need careful cleaning with a small toothbrush after use.
- The hand-held screwdrivers, manual torque wrenches and bone mills need to be dismantled before sterilizing and reassembled at use. This depends on the implant system being used. If in doubt contact the manufacturer of the system or look in the catalogue for guidance.
- Components such as direction indicators need to be threaded with floss for safety during use in the mouth. Do not thread with waxed floss as it becomes brittle after the sterilization process.

- When ultrasonic cleaning the drills and loose components, place them in a Pyrex beaker for safety. They are small and can easily be lost.
- Handpieces will need running through, cleaning, dismantling and oiling before sterilization.

Decontamination of the dental surgery and aspiration system

- Clear away all instruments and equipment.
- Decontaminate the dental surgery in the usual way.
- Clean the filter on the aspirator.
- Run the suction unit through with an appropriate disinfectant.
- Re-set the unit for next the patient.
- Have a well earned coffee/tea!

When assisting for the first time with the placement of an implant, an implant regional representative will often, if contacted, come along and give support. Remember to plan and discuss with the clinician the needs of the practice then things should run smoothly because the whole team will know what to expect.

Review appointment

One week following the surgery, the patient will have the sutures removed and a postoperative check. The dental nurse may be required to assist with the suture removal.

Instruments

- Mirror
- Straight probe
- College tweezers
- Suture scissors
- Chlorhexidine mouthwash
- Sterile gauze
- Personal protection equipment
- Postsurgical toothbrush (soft)
- Hand mirror

The dental nurse may be asked to provide oral hygiene instruction.

Second-stage surgery

If a two-stage surgical approach has been organized in the treatment plan, the following protocol is used. Aseptic technique is again important. The area will

be opened with a tissue punch or a routine flap will be raised. A basic surgical kit will therefore be required with local anaesthetic.

Aspiration will aid vision for the clinician. Once the implant has been located the clinician may require a bone mill to remove bone that may have grown over the implant cover screw. Bone mills need to be assembled to the manufacturer's instruction. Sterile dental floss should be attached for safety.

Once the cover screw has been removed, the healing abutment will be placed and the area re-sutured so healing can take place.

In the preplanning for this procedure, the dental nurse needs to order the components required for this stage, usually the healing abutments. The dental nurse needs to ensure that the clinician decides on the required components so they can be ordered and received before the patient attends. When healing has taken place an appointment will be made for the impressions to be taken.

The prosthodontic stage

Following second-stage surgery and fitting of the healing abutment the prosthodontic stage takes place. The clinical time for the stages can vary from one visit to several visits, depending on the complexity of the individual case.

As impressions for the prosthetic restoration is the next treatment stage, ensure that the relevant impression copings and abutments are available for the patient's visit. Planning and preparation for this stage are just as important as surgery preparation. Discuss with the clinician which type of impression will be taken so that relevant impression copings and abutments can be ordered. The clinician may require a range of sizes of abutments as for implant placement. At this visit the healing abutments will be removed and the abutment and impression copings will be positioned.

The purpose of the implant level impression is to relate the position of the implant platform to other implants, teeth and soft tissue contours. The implant level impression is generally made after second-stage surgery, after a healing abutment has been in place and the gingival cuff has formed (Nobel Biocare 2002).

The clinician has the choice of two impression techniques: the closed-tray technique and the open-tray technique.

Closed-tray technique

The impression copings stay in the mouth attached to the abutment or implant fixture as the impression is taken out. The copings are then removed and reseated into the indentations in the impression. This provides an accurate position for the implants.

Open-tray technique

The impression copings are still connected to the abutments or implant fixtures, but the screws project holding the impression coping first have to be released and then the impression can be removed from the mouth. The copings are securely fixed in the impression once set.

Whatever technique is chosen, the clinician will use an elastomeric impression material. It is vital that standard infection control protocols are followed when mixing the impression material and before the impression is sent to the laboratory. It is usual for light body impression material to be syringed around the impression coping. The heavy body is mixed and loaded in the tray as with a standard crown or bridge impression.

An occlusal registration is taken using a face-bow either at this stage or the next visit. An opposing impression is then taken so that the study model can be articulated for the technician to have a true replica of the occlusion. Inter-occlusal records will also help as implants must not be heavily loaded. Mousse or wax can be used for taking these records. A shade for the crown or bridge will also be taken. During shade taking, remember to adjust the dental light away from the patient to give as much natural light as possible; sometimes this may mean asking the patient to stand by the window. After the impressions protective silicone caps are replaced onto the abutments before the patient leaves or healing caps replaced onto the implant fixtures. Some patients are happy to stay like this until the permanent crown or bridge can be fitted. Temporary crowns or bridges can be made. If this is the case the temporary crown or bridge will be fitted using a temporary material. If temporary dentures are being worn then the healing abutment may be replaced so the patient can continue to wear the dentures until the final crown or bridge work is ready.

Instruments and materials required for the impression stage

- Mirror
- Probe
- Periodontal pocket measuring probe (to help select the height of the final abutment)
- College tweezers
- Local anaesthetic (in case of overgrowth of the tissues around the healing abutment)
- Sterile scalpel handle and blade (so adjustment can be done if overgrowth has occurred)
- Hand-held screwdrivers (for removing healing abutment and placing the final abutment)
- Bone mill with dental floss attached as a safety measure (for removing excess bone growth over the fixture if the healing abutment has become loose since second-stage surgery)

- Impression copings for either open-tray or closed-tray technique
- Radiographs (to check copings are down or if there is a problem with the implant)
- Disposable impressions trays (upper and lower with handles)
- Universal adhesive
- Alginate
- Silicone impression material (light and heavy body), guns and tips
- Pink modelling wax for covering open-tray holes (this helps to support the heavy bodied impression material)
- Scissors (for trimming temporary crowns)
- Handpiece – acrylic trimmer, polishing burs
- Temporary crown forms
- Temporary cement for crowns
- Dappens pot (for monomer)
- Spatula and pad
- Shade guide (vita lumin)
- Universal adhesive (to attach material to tray)
- Integrity and gun or trim (to make temporary crowns)
- Articulating paper with Miller forceps ×2 (to check occlusion)
- Face-bow
- Wax
- Ultrasonic bath (to clean healing abutments if being replaced until final work)
- Jaw registration paste

Procedure for a single tooth restoration

Closed-tray impression at abutment level

- Remove healing abutment from implant fixture and place the abutment on the fixture
- Radiographic confirmation of abutment fitting
- Radiographic confirmation of seating of coping
- Final tightening of abutment with torque wrench
- Impression procedure
- Jaw registration
- Shade
- Provide a temporary crown, a protective silicone cap or refit a partial denture following removal of the abutment and replacement of the healing abutment

Procedure for a single tooth restoration using an open-tray impression

- Remove the healing abutment
- Place impression coping directly to the implant

- Radiographic confirmation of abutment fit
- Take impression
- Unscrew the impression coping so the impression can be removed from the mouth
- Replace the healing abutment

This is sent to the laboratory for the abutment and crown to be made. The customized abutment and crown can be made at the same time.

Procedure for multiple restorative case (bridge) (Searson et al. 2005)

This process is similar to that for a single tooth but with more implants.

- Remove any partial dentures or bridges
- Select the abutments (if the impression is abutment leve)
- Remove the healing abutments
- If the patient is wearing a temporary bridge the temporary abutments may already be in place which will need to be removed
- Seat the impression copings either on fixture or abutment
- Take a radiograph to confirm the fit
- Take an impression
- Depending on number of teeth remaining, either jaw registration and occusal record can be taken at this visit or may need another visit
- Jaw registration sent to the laboratory
- Occlusal record sent to the laboratory
- Re-cement the temporary bridge or replace the partial denture/bridge
- Try and check the bridge on the patient's return visit
- Metal try-in (if the bridge is extensive this is advisable so the thickness of the porcelain or acrylic can be assessed)
- Make final placement of restoration

Try-in and fit stage of an implant prosthesis

At the try-in stage check the following:

- the contours and shape of the restoration
- the occlusion
- if any adjustments are required to the crown or bridge
- that the abutment and crown are seated correctly
- the patient's opinion

On confirmation of fit and appearance the laboratory will finish the restoration and add porcelain, with the staining and glazing. The crown or bridge will then be ready for fitting at the next visit.

Fitting of prostheses

Implant crowns or bridges can be screw or cement retained. There are three types of screw-retained prosthesis:

- screw retained direct to the implant body
- screw retained direct to an abutment
- screw retained with a lateral screw on custom-made abutments.

Cement-retained prostheses may be placed on pre-manufactured or custom-made abutments.

Once the final adjustment has been made the crown or bridge is cemented using a luting cement. It is essential that the crown or bridge is not over-filled with cement. Dental floss and damp gauze can be used to remove excess cement. Good aspiration may also be required.

If the prosthesis is screw retained, gold or titanium prosthetic screws are used to connect the restorative to the abutment. You will need to ensure that the appropriate implant screwdrivers are available. Gauze is often placed in the oral cavity to prevent inhalation of the small screw should it be dropped. The screw head should be protected and sealed with an impression material that is easy to remove (Hobkirk et al. 2003) (Nobel Biocare 2002).

Postoperative instruction

Following the fitting of the crown or bridge postoperative care should be given. Good oral hygiene is essential to ensure the stability of the restoration. The importance of the patient's home maintenance cannot be over-emphasized. Toothbrushing techniques should be reinforced, and flossing and interspace cleaning checked. A review appointment should be arranged in case of any problems.

A follow-up routine scaling and polishing appointment may be arranged as a preventive treatment. The scalers and curettes used for this procedure need to be titanium friendly, and plastic or gold tipped.

Procedure for an edentulous patient with full over-dentures

Dentures can be retained using either a ball attachment or a bar-retained on the implant. These dentures are called over-dentures:

- **A ball attachment denture** is a tissue supported conventional over-denture retained by abutments that are connected directly into the implants.
- **A bar-retained over-denture** is a conventional acrylic denture retained by clips which fit onto a bar.

The denture is usually tissue supported and implant supported. Intra-oral considerations and manual dexterity will determine the type of over-denture (Nobel Biocare 2002) to be used.

The prosthetic stages for implant-retained over-dentures are very similar to routine full/full denture construction. On removal of the healing abutments the fixture/abutment head is sealed using a silicone cap. A primary impression is taken to enable the position of the implants to be recorded. The impression can be taken in a stock tray using impression compound or silicone putty with a wash. This should provide a detailed impression so the special trays can be made. If the prosthesis is to be fixed, a special tray can be constructed with holes added so that an open-tray technique can be used. The abutments are connected at the next visit and secondary impressions taken in elastomeric impression material.

A jaw registration is taken at the next visit with a wax rim on an acrylic base. Once the jaw registration has been taken, teeth are selected and a shade is chosen. At the next visit at the try-in, when the denture is set in wax, the aesthetics and occlusion as well as the lip support is checked. The metal framework, if it is a bar retained over-denture, will also be checked as the next appointment for fit. Once the bar is seated passively at the next visit both the wax and metal are tried in together and if all is well the laboratory is instructed to finish. On the final visit the bar and denture are fitted and postoperative care and maintenance are given for both the denture and the implant. If the denture is a 'ball' retained over-denture then the 'bar' try-in stage is omitted and the secondary impression taken at abutment level after the ball abutment is connected.

Postoperative care for dentures and implants

- Dentures should be cleaned following a meal wherever possible and the mouth rinsed.
- Dentures should be left out at night because of reduced saliva flow.
- Cleaning the denture should be done over a basin of water using a soft toothbrush and soap.
- The dentures should be kept in water to prevent them from drying out.
- Clean the abutment fixtures using an interspace toothbrush, toothpaste and floss.
- If a patient should experience any problems they should contact the surgery for advice or ask for help at a follow-up appointment.

These are guidelines to assist the dental nurse during the process of implant restorative treatment. However, as with any dental treatment techniques may vary as clinicians have their own preferences and adaptations to a treatment plan. Hopefully the guidelines will aid understanding and enhance the nurse's ability to pre-empt and anticipate the needs of the patient and clinician. Be prepared to adapt these techniques as treatments for dental implants develop.