Orthodontic Products Update

Cortical Bone Screws for Maxillomandibular Fixation in Orthognathic Surgery

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Introduction

Handicapping malocclusions can be managed by combined orthodontic and surgical treatment. Orthognathic surgery requires temporary intermaxillary fixation (IMF) to achieve and hold the correct occlusion for segment reduction and plating. Traditionally, this is achieved using ball hooks and brackets. The problems inherent in this technique include inadequate number and/or position of the ballhooks and perioperative shearing off the brackets. Recently, several authors have advocated the use of transosseous alveolar screw techniques to establish easy, quick and safe maxillo-mandibular fixation, in facial trauma surgery[1,2] (Arthur and Bernardo, 1989; Jones, 1999). Similar methods are applicable as an alternative to orthognathic surgery.

The use of wires passed around conventional trans-osseous screws is a good alternative treatment for maxillo-mandibular fixation, but the wire can slip over the head of the screw and there are problems with mucosal coverage. Specially designed bone 'capstan' screws dedicated to temporary IMF are now available (Surgical Technology Ltd, 44-46 Lower Bridgeman Street, Bolton BL2 1DG, U.K.)

Features

Screws are manufactured in titanium with a 2-mm diameter self-tapping thread. They have a capstan style head and are inserted and removed with a centre drive hexagonal screw-driver. They are available in thread lengths 10–16 mm.

Method

Intra-operatively holes are pre-drilled at the junction of the attached and reflected mucosa, avoiding the roots of teeth. Drilling may be performed trans-mucosally—a gingival incision is not required. The appropriate thread length is selected and the screw placed using water as coolant. The best position has been found to be between the canine and first premolar. One screw in each quadrant is usually sufficient. Fixation can be achieved with either stainless steel wire or small elastic bands (Fig. 1).

The screws may be removed after placement of internal fixation or more usually retained for post-operative elastic traction. They may be used either as an alternative to bonded hooks or to complement them.

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FIG. 1 IMF screws *in situ* with elastics.

Advantages

1. Decreased operating time.
2. Easy painless removal in the outpatient clinic, usually without the need for anaesthesia.
3. Ideal for use when teeth have been crowned or bridged.

Cost

The price for a pack of 10 is between £139.60 and £149.60, depending on screw length.

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Digital Cameras

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Introduction

The capture and reproduction of clinical images is an important part of orthodontic practice. The images may be used for several purposes including both patient and professional education and medico-legal purposes.

Although clinicians vary in the hardware which they use to take images, for example some use a conventional 35mm body with a macro lens whereas others choose a specifically designed camera for dentistry, the images are usually recorded onto 35mm photographic film. These are processed as either prints or slides. However, with the advent of digital cameras, it is now possible to use these for recording dental images electronically with acceptable results (Hutchinson et. al., 1999).

In the context of a busy orthodontic clinic, the main advantages of using digital cameras are:

1. Speed and immediacy of image capture, in particular allowing immediate review and re-exposure of unsatisfactory images.
2. Provided that the associated computer system is appropriately set up, cataloguing and storage of the images is simplified.
3. Incorporation of the images into documents and presentations is greatly simplified.

A digital camera captures the image on a charge-coupled device (CCD) instead of film. The finer the grid of the CCD then the greater the amount of detail recorded. The basic unit of image detail is known as a 'Pixel' (short for 'picture element').

In the review by Hutchinson et al. (1999) the highest resolution of the cameras tested was 1280 × 1024 pixels (more conveniently known as 1·3 Megapixel). The rapid advancement in technology has now produced CCDs capable of recording an even higher number of pixels, therefore increasing the amount of detail found within the image. The quality of digital images is now more than acceptable for clinical use.

There has also been a reduction in the cost of the cameras such that many are cheaper than a conventional 35mm camera and the accessories needed for clinical use (e.g. ring flash). The latest cameras now being released into the 'consumer' sector of the market have maximum resolutions of 1600 × 1200 pixels (2·1 Megapixel) or greater, and allow a greater degree of exposure control. These developments now obviate many of the disadvantages associated with earlier digital cameras as compared to conventional systems.

Features to consider

Liquid Crystal Display (LCD). Unless the camera is of the SLR type, close up work is best done using the LCD to frame the image, instead of the viewfinder, to eliminate the parallax problem associated with the viewfinder. If so, the frame refresh rate of the LCD needs to be sufficiently fast to eliminate blurring and drifting of the image in the frame as the exposure is taken. The LCD is also important for reviewing the image immediately after it has been taken.

Mains adaptor. Use of the LCD as discussed above has the disadvantage that it consumes batteries at an alarming rate. An alternative is to use rechargeable batteries, which some companies provide. Best of all is to have the option of using a mains adaptor, ensuring that the camera can always be ready for use. Some of the cameras investigated cannot be linked with an adaptor, whilst with others it can only be bought as an optional extra.

Software. Digital cameras store images as graphic files (usually in the JPEG format), and are supplied with their own software to allow the image files to be downloaded into a personal computer (PC). The ease of use of this software varies and is subject to individual opinion. We recommend that the software should also be tried out prior to purchase.

Resolution. The more pixels recorded by the camera, then the greater the amount of detail captured, so it is best to go for the highest within your budget. A 1·3 megapixel or higher camera can produce a 6″ × 4″ print that is 'photo-realistic'. The current standard is around 2 megapixel, but is likely to go higher. However, the actual resolution at which the image is captured may not be important if a photo-realistic print of the image isn't needed, so the ability of the camera to record at lower resolutions also can be useful.

Number of images stored internally. This will depend on the size of the memory card provided with the camera (for a given resolution at which the image is stored). It is possible, at an additional cost, to buy a larger memory card, which will allow more images to be stored. The fewer images that are able to be stored in camera, then the more frequent downloading to the PC is required.

Practical Considerations

Downloading of images. This is necessary, as the images can only be properly labelled and catalogued once stored on computer – until then, they just have a camera-generated number. Most cameras come with a variety of cables to allow connection and downloading of images to a PC, but these are not particularly quick or convenient. The most common method of storing the images in the camera is with removable media such as SmartMedia cards (Olympus, Fuji, Agfa and Ricoh cameras) or CompactFlash cards (Kodak, Minolta, Nikon and Canon). Various peripherals, such as a PC card adaptor or floppy disk adaptor, are available to enable direct connection of the cards to the computer. These make downloading much easier and quicker, and are well worth having.

Reproduction. The stored images can be printed out when needed using the supplied software or by pasting them into other software applications, such as a Word Processor. As usual, the print quality varies with the hardware used. We have experience of using the inkjet Epson Stylus 750, which is currently highly rated in reviews and costs around £200. Using glossy photographic paper, and printing at the highest quality setting (for jargon buffs this is 1440 × 720 dots per inch), it is hard to tell the difference from conventional 35mm prints. This is slow and rather expensive, however, but it is possible to print at lower resolutions onto plain paper. Colour laser printers will also give excellent results, but are still very expensive.

Production of clinical slides for projection via computer, video projector and software such as Microsoft PowerPoint is also very easy using the images captured from a digital camera. Slides produced in this way fill the screen with no loss of detail when the images are created at resolutions higher than 1·3 megapixel and viewed at standard resolution.

Storage and filing. It is possible to incorporate the image files into some of the dedicated practice management software currently available, for example Keybase K5 Photo. Alternatively, users can set up their own filing systems or purchase specific software to do this. A typical clinical image saved as JPEG file is between 300 and 500 KB, so careful consideration needs to be given to the disk size and type (such as fixed or removable, magnetic or optical) needed to store a reasonable number of images. The printing and storage of digital images will be the subject of further reviews in this series.

Batteries. If a mains adapter is not used it is advisable to use the more powerful Nickel Metal Hydride (NiMH) rechargeable batteries, and keep a battery charger in the surgery with a spare set of batteries on charge. A typical package of charger and set of four AA NiMH batteries costs around £20.

Radiographs. Images of radiographs are easily taken. The film is simply placed on a viewer and the camera adjusted so that the radiograph fills the LCD/viewfinder. This image can then be printed or made into a slide for projection.

Test results

The magazine 'What Digital Camera' listed 58 cameras in the October 1999 issue, ranging in price from £200-£5000, but with most costing between £400 and £800. We looked at several cameras in the 'megapixel' (or better) category, and with most of these, there were some features that made them seem less attractive for use in orthodontic practice. These were, for example, a slow LCD refresh rate; overcomplicated operation; and lack of control over aperture settings. Some of these are described in Table 1. We felt that the latest '2 megapixel' cameras now have sufficient resolution to provide more than adequate detail of the dental arches. Readers will hopefully appreciate that we decided to concentrate on just two cameras for a more detailed description.

We were attracted to the Nikon Coolpix 950 because of

TABLE 1. *Selection of cameras which could be suitable for orthodontic use (in order of cost).*

Camera	Cost (£)	Max resolution	Macro setting	Supplied memory Storage Media	Lens size (equivalent)	AC adapter	Comments
Ricoh RDC-4200	499	1280 × 960	8cm	4MB SmartMedia	35–105mm	No	Good macro, but no optical viewfinder.
Olympus C 900 Zoom	499	1280 × 960	30cm	4MB SmartMedia	35–105	Optional Extra	Poor macro and lower resolution, so just not quite good enough for intraoral views.
Nikon Coolpix 700	499	1600 × 1200	9cm	8MB CompactFlash	38	O/E	Good macro, but non zoom lens.
Kodak DC265	600	1536 × 1024	20cm	8MB CompactFlash	38–115	No	Complicated controls. Slow LCD refresh rate.
Ricoh RDC5000	650	1800 × 1200	4cm	8MB SmartMedia	38–86	O/E	Excellent macro. Slow. Poor exposure control for price.
Fuji MX2900	700	1800 × 1200	25cm	8MB SmartMedia	35–105	Yes!	Biggest resolution yet. Complex controls. Slow recovery and playback.
Sony Cybershot F55	700	1636 × 1236	10cm	Memory Stick	37		Non zoom lens, but otherwise many features.
Olympus C2000z	745	1600 × 1200	20cm	8MB SmartMedia	35–105	O/E	Manual exposure controls. Macro Conversion lens O/E. Fast recovery and playback. Still expensive.
Nikon Coolpix 950S	799	1600 × 1200	2cm	8MB CompactFlash	38–115	O/E	Superb macro. Manual exposure controls. A bit complicated. Expensive.

FIG. 1 The Nikon Coolpix 950s.

the favourable findings with its predecessor, the Coolpix 900 (Hutchinson et al, 1999), and its superb macro facility which allows focusing down to 2cm. The Olympus C2000Z was chosen because (along with the Nikon) it offers a degree of manual exposure control appropriate to 'professional' use. It is also likely be the best seller in its class when this article appears in print!

Nikon Coolpix 950s (figure 2)

The Camera. The current shop price is just under £800. Our first impression is that the Nikon is well made and solid (apparently the swivel mechanism between the two halves of the camera has been strengthened). The camera itself is fairly compact, although it doesn't appear to be as streamlined as the earlier 900, as reviewed in a previous article (Hutchinson et. al., 1999). The Nikon is supplied with an 8MB card and comes with Adobe Paintshop version 5 software for image manipulation. The test camera was supplied with the Premier kit, comprising an additional 10MB card, a mains adapter and a set of NiMH rechargeable batteries.

For our tests, we used the AC adapter to power the camera. The cable is of sufficient length not to cause any real problems within the surgery. The main problem with this is that the jack is inserted into the top of the camera. Consequently the cable is bent through 180 degrees as it hangs down. It may be advisable to place some Velcro or an adhesive pad on the side of the camera and attach the cable to this. This will provide additional support and prevent the cable from swinging round in front of the lens during exposure

The Nikon can be used in fully automatic mode but is also capable of certain manual exposure controls. In the manual setting, the operator can set the camera to aperture priority (the camera will adjust the shutter speed to correct the exposure) or shutter priority (the camera will adjust the aperture to correct the exposure). In this test the camera was set to the fully automatic mode.

The camera also has the ability to alter how the metering is achieved. It is possible to use spot metering where a single area is used or matrix where the camera divides the frame into areas and takes an average reading. The matrix mode was selected.

Taking the images. The macro setting with maximum zoom was selected. The image quality was set at either fine, normal or basic. The operator then simply moved the camera either towards or away from the object until a satisfactory frame was achieved. The camera then took a second or so to focus and the 'shutter' button was depressed. Using this technique it was possible to take an image of the upper and lower labial segments (figure 2) and then simply move closer if additional detail/close up was required (figure 3). The camera focused itself.

With regard to lighting, it was possible to use the flash with the dental operating light switched off to achieve satisfactory results. However, we would not recommend this, as it is difficult to view the frame, due to lack of light prior to capturing it. We found the best way is to switch off the flash and use the dental light to illuminate the teeth. This allows the operator to easily see the frame and record it. We also achieved excellent results for capturing radiographs and study models.

Transferring the images. The camera is supplied with a cable to connect to the serial port on the computer. Using this, however, takes several minutes to download images to the PC. We would therefore recommend the purchase of a

FIG. 2 Anterior view, taken with the Coolpix 950s at normal resolution.

FIG. 3 Close up anterior view, taken with the Coolpix 950s.

PC card adapter (about £20). The camera's CompactFlash card inserts into this, allowing images to be transferred within seconds.

Which resolution? We tried the same subject at each of the three resolution settings possible; basic, normal or fine. For practical use, i.e. when printing the images at photograph size of 4″ × 6″, or when viewing the images projected full screen using Powerpoint, there was no difference in the level of detail seen. The 'fine' resolution setting will allow a greater degree of enlargement of the image without loss of detail, but for everyday use we would suggest the 'normal' setting (see figure 2). At this resolution, typical images are approximately 450Kb in size. It is thus possible to store approximately 16 images on the 8MB card and 20 on the 10MB card included in the premier kit. If needed, larger Compactflash cards are available. 16MB cards, for example cost around £85.

Olympus C2000Z (figure 4).

The Camera. As with the Nikon, the Olympus looks and feels well made, and at least looks like a camera, unlike some of the offerings from other manufacturers. The current shop price is around £750. Supplied with the camera is a remote controller, which would be useful when using a tripod, but this was not tested. An AC adaptor is available as an optional extra, which plugs into the side of the camera. In daily use we have found it more convenient to use rechargeable NiMH batteries, with a charged-up spare set on hand. In typical use, about 20 clinical exposures could be taken on one set of batteries.

The Olympus also comes with a plethora of cables (none so far used!) to connect camera to PC, Apple Mac or TV. Image storage is via an 8MB SmartMedia Card (additional 8MB cards cost around £20). The supplied software is very basic in comparison to the Nikon, but can be used for downloading and cataloguing of images, and basic image manipulation. We also acquired a Fujifilm 'FlashPath' card adapter, into which is inserted the SmartMedia Card from the camera. The adapter then slots into the standard 3·5″ floppy drive of the PC and replicates the A: drive.

FIG. 4 The Olympus C2000Z.

The camera has 3 resolution settings, with the maximum of 1600 × 1200 pixel in the HQ (presumably = High Quality) or SHQ (Super High Quality) modes. The difference between HQ and SHQ is the level of compression of the resultant image file. The more basic HQ setting allows the operator to choose either 1024 × 768 pixels or 640 × 480 pixels. The optical zoom gives focal length settings equivalent to 35-105mm. A further digital zoom is available, but this is at the expense of image resolution, and gives no differences in practice to taking the images at 1× magnification and then subsequently enlarging the image through software.

Setting up and controlling the camera is very straightforward after a little practice, being mostly via a menu system visible in the LCD and a jog key to move the cursor. The camera can be used in fully automatic mode, but does allow manual setting of aperture priority and shutter speed priority via the rotating control dial on top of the camera. Other settings, such as focusing range (including macro setting), exposure compensation, flash over-ride, centre-weighted or spot metering, white balance (to compensate for different kinds of artificial light) are controlled via a menu visible in the LCD whilst framing the subject.

Taking the images. After experimenting with the camera using the most of the settings, we achieved the best results using the following techniques to obtain the standard clinical images. All images were taken at the highest resolution of 1600 × 1200 pixels, on the HQ setting, which produces a JPEG file at a higher degree of compression than for the SHQ setting, but is much quicker, and about 20 HQ images will fit on the 8MB card. The images were framed using the LCD monitor, which is very clear and has a suitably high refresh rate. Unfortunately, the actual moment of exposure was not immediately apparent when using the display, and some practice was needed at keeping the subject framed during exposure

Facial views. These were best taken using the red-eye flash setting, with the zoom setting about half way and framing from about 1m. All other settings were left on automatic. An example of this is shown in figure 5.

Intraoral views. Aperture priority was selected, at the maximum of f11. The dental light was left on to help illuminate the subject, and the flash setting left to auto (it usually fired). The lens was set to full zoom, and the macro setting selected. The subject was framed from 20cm, taking care to hold the camera just underneath the beam of the dental light. With this technique, the dental arch does not quite fill the frame, but we found it easier to achieve consistency by accepting some unwanted soft tissue and then 'crop out' this from the saved image at the downloading stage, rather than using the digital zoom feature on the camera. As can be seen from figures 6–8, the results are quite acceptable, and the depth of field excellent. If, however, it is important to image intraoral tissues at a higher optical magnification, Olympus supply a macro conversion lens, which screws on via an extension tube over the built-in lens. This greatly improves the close-up capability, but does then need to be removed for extra-oral views.

Study models. Using a suitable background, the models are carefully illuminated using the dental light from directly above, so as to minimise shadowing. The lens is set on full zoom with macro, aperture priority to f11 and all other settings left on automatic. An example of this is shown in figure 9.

Review and transfer of images. The recovery the time of the Olympus is very fast, allowing review of images almost immediately after exposure. Unsuitable images can simply be deleted on-camera with two key presses and then retaken. Using the Flashpath adapter (cost about £70),

FIG. 5 Facial view, taken with the C2000Z.

FIG. 6 Upper occlusal view, taken with the C2000Z.

FIG. 7 Right oblique view, taken with the C2000Z.

FIG. 8 Left oblique view, taken with the C2000Z.

FIG. 9 Study models, taken with the C2000Z.

images can be downloaded to computer very quickly. Once on the destination drive, they can be rotated (if taken with the camera in 'portrait') cropped of unwanted surrounding tissue and enhanced, for example by changing the brightness or contrast, and given a meaningful file name. With practice, this can be done in a matter of seconds.

Conclusion

Whilst even at 2 megapixel resolution digital images fall some way short of the resolution afforded by conventional 35mm film, we found both cameras tested to be very suitable for use in our orthodontic practices. The major advantage with the Nikon was the much shorter macro distance of 2cm, as compared with the Olympus' 20cm (without the conversion lens). However, unless there is a requirement to photograph individual teeth or small lesions, this difference is not important in the ordinary orthodontic setting. We felt that the Olympus was easier to use, and is more compact and versatile for general use.

Since both cameras otherwise attract excellent reviews in specialised magazines and are similarly priced (although the Olympus is likely to be cheaper), choosing between the two cameras will probably come down to individual preference. These comments reflect our views only, and readers would be well advised to study the reviews and specifications given in magazines such as 'What Digital Camera' for more authoritative information. Before you buy any camera, we would strongly recommend that you test an example of it in relation to your own clinical needs.

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