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SOP – osteotomy and reduction guide system

Deformity correction

Please read these notes carefully and contact us immediately if you require any additional information or have any concerns about the printed models or guides supplied.

Pre-operative

- Unless specified otherwise, two bone models and two guides will be supplied.
 - Pre-operative bone – translucent yellow plastic – for pre-op / intra-op practice of osteotomy guide fit – this can be autoclaved.
 - Post-operative bone – white plastic – usually with footprint of reduction guide *in-situ* – for pre-contouring of plate – autoclaving not recommended.
 - Osteotomy and reduction guides – biocompatible and autoclavable translucent orange plastic. Recommend autoclave protocols are below, however all standard protocols are acceptable.
 - 138°C for 3 minutes
 - 134°C for 6 minutes
 - 121°C for 15 minutes
- **Four Ellis pins will be required, and ideally four drill bits of similar or slightly smaller diameter.**
 - The diameter varies according to patient size and will be confirmed following guide design and in this SOP when supplied with the models.
- The 3D bone models, and especially the osteotomy and reduction guides, are UV light sensitive and should be stored away from direct sunlight (e.g. in a draw or box). Extended exposure to UV light may reduce the strength of the guides.

Intra-operative

- **A standard surgical exposure of the affected bone is made.**
 - Whenever possible the guide system will be designed to be applied to the most easily accessible aspect of the bone to be corrected, e.g. lateral humerus, medial tibia etc. Positioning of the guide system will be discussed with the surgeon during the planning stage.
- **Elevate soft tissues to the extent required for the osteotomy guide footprint.**
 - Supra-periosteal exposure is appropriate i.e. as for plate application.
 - Note that adherent soft tissues of any significant thickness will adversely affect guide fit and should be removed – in juxta-articular locations these might include retinacular and capsular attachments, and in remodelled regions adherent fibrous material.
- **Identify the position of osteotomy guide fit.**
 - This is usually obvious as the guide becomes stable once it's footprint matches the cortical contours beneath.
 - Comparison to the printed bone helps identify the correct position.
- **Apply the Ellis pins through their channels (Figure 1).**
 - Pre-drilling of the *cis*-cortex only with a drill bit of the same or slightly smaller diameter than the Ellis pin is recommended. Carefully align the drill bit with any one of the channels such that off-axis pressure on the guide channel (which could move the guide) is avoided. The transparent, cylindrical nature of the channels facilitates alignment.
 - Ideally after each *cis*-cortex is drilled the drill bit is left *in-situ* and a new bit used for the next hole. In this way the position of the guide cannot change, however with careful technique this can be achieved with fewer drill bits.
 - Each drill bit is removed sequentially and replaced with a bicortical Ellis pin.
 - If the drill chuck, or later the saw attachment, will contact the end of the previously placed Ellis pin, that pin can be cut leaving about 1cm emerging from the guide channel.

- **Cut the connecting bars between the osteotomy guide planes (Figure 2).**
 - Cut the connecting bars flush with the osteotomy guide plane surfaces using an oscillating saw blade held parallel to, and in contact with, each plane.
 - Although the guide material is biocompatible, a moist swab can be placed between the bars and the bone to catch debris, and the area then lavaged.
- **Make the osteotomy / osteotomies (Figure 3).**
 - **Ensure the oscillating saw blade remains parallel to, and in contact with, each plane.**
 - Occasionally the guide may ride up the Ellis pins due to contact with the blade – a bone clamp or manual pressure will prevent this.
 - It is often helpful to change the angle of attack of the blade once the osteotomy has been started. This is sometimes necessary to avoid contact between the saw and the top of the guide plane.
- **Remove both ends of the osteotomy guide (Figure 4).**
 - These should slide off the Ellis pins.
- **Place the reduction guide (Figure 5).**
 - This will align all four Ellis pins in parallel, and, when contacting the cortex proximally and distally, results in optimal re-orientation of the proximal and distal bone segments as pre-planned.
 - Note that for closing wedge osteotomies the guide may bind due to friction between the osteotomy surfaces if these are poorly aligned. **It is very helpful to manually reduce the bone segments with all four Ellis pins parallel and the osteotomy surfaces appropriately reduced before sliding the reduction guide down the Ellis pins.**
 - Full length Ellis pins are not necessary – it is easier to slide the guide if these have been shortened. Sterile lubricating jelly applied to the pins can also make it easier to place the guide.
 - Contact between the guide base and the cortex proximally and distally is necessary for planned alignment – if required non-pointed reduction forceps can be used to push the guide onto the bone.
 - Please note the reduction guide is designed to be as strong as possible within the size limitations imposed by patient size, but is not indestructible. **Avoid the use of excessive force or application of point loading** (e.g. pointed reduction forceps) – large forces should not be necessary if the above guidelines are followed.
- **Apply the precontoured plate (Figure 6).**
 - This will be applied adjacent to the reduction guide.
 - Check that the Ellis pins do not impede planned screw pilot holes. Should this occur pilot holes for cortical screws can usually be slightly angled; for locking screws removal of the Ellis pin once sufficient other screws have been placed is necessary.
 - Do not attempt to compress the osteotomy with the reduction guide attached with all four Ellis pins as this will produce stress at the pin / bone interface. If you wish to compress the osteotomy the plate should be applied securely with at least two screws either proximally or distally. A screw is placed at the other end of the plate in a loaded position, in contact with the plate but not tightened. One pair of Ellis pins is removed (from either end), and the screw tightened. Obviously undesired relative movement of the osteotomy segments is possible but unusual unless plate contouring is inaccurate. Lightly applied bone-holding forceps between the reduction guide and bone can help maintain alignment but still permit slight compressive movement of the bones.
- **Remove the reduction guide and Ellis pins.**
 - A second plate can be applied in the vacated space if necessary.

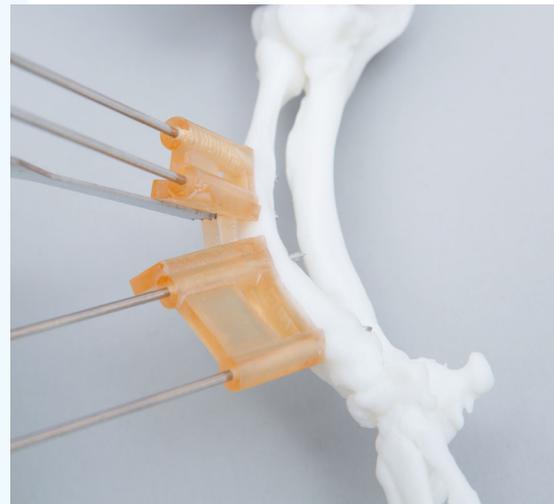
Post-operative

- We actively encourage feedback – please let us know your thoughts.

Figure 1 – The osteotomy guide has been applied to the deformed bone and stabilised with four Ellis pins



Figure 2 - Oscillating saw plane orientation (parallel to and in contact with the osteotomy guide plane) during connecting bar cutting and the osteotomy



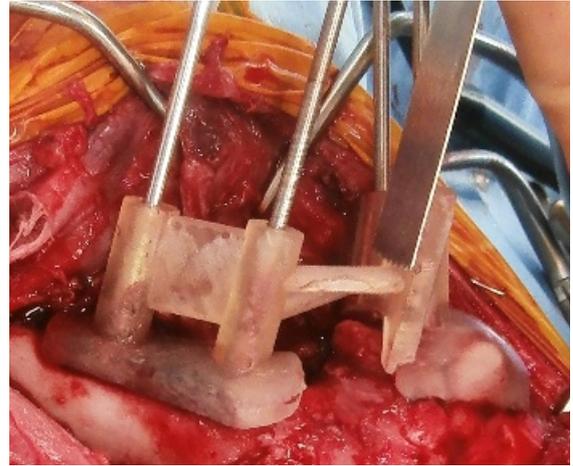


Figure 3a – the osteotomies have been completed parallel to the guide planes

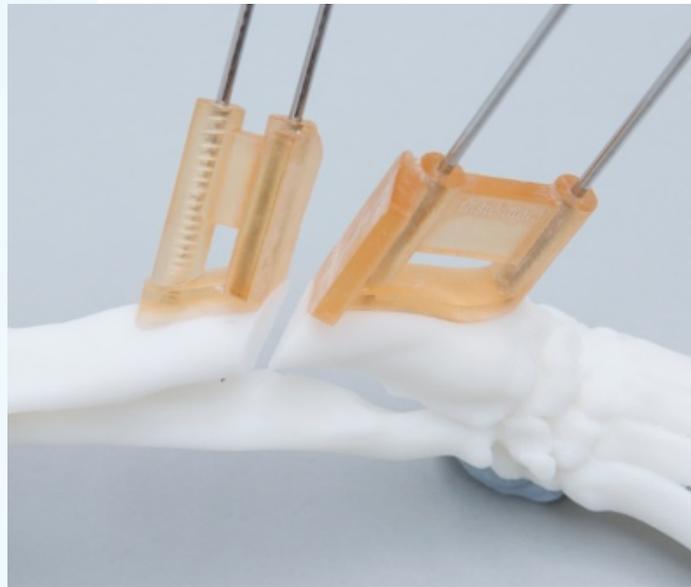


Figure 3b – the osteotomies have been completed parallel to the guide planes

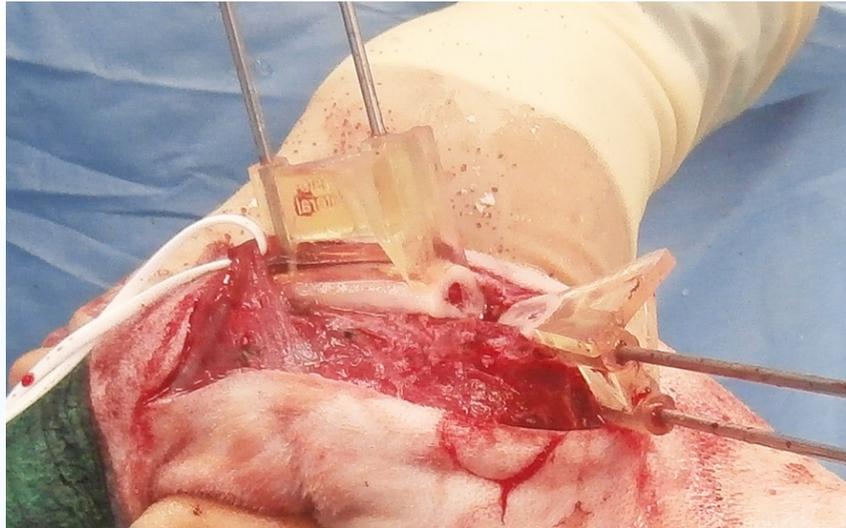


Figure 4 – the two ends of the osteotomy guide have been removed



Figure 5 – the reduction guide has been slid along the Ellis pins aligning the proximal and distal bone segments as planned. Reduction is maintained for plate placement



Figure 6 – the precontoured plate is applied adjacent to the reduction geode. The guide and pins are then removed.

