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OSTEOTOMY JIG

FIELD OF THE INVENTION

The present invention relates generally to osteotomy guide to facilitate angled cuts in a long bone. More particularly, the invention relates to a jig which allows precise angle(s) and positional adjustment for malunion correction osteotomy.

BACKGROUND OF THE INVENTION

Metacarpal malunion can be complicated by malunion with dorsal angulations and shortening of the bone. Dorsal angulations can be symptomatic with weakness of grip and pain of grasp. Grasp pain is due to prominence of the metacarpal head. Conventional method of correction of dorsal angulations such as opening and closing wedge osteotomy results in a change in length and may require a second operation for bone grafting.

A new single step procedure for correcting dorsal angulations without altering the bone length significantly, namely Rhomboid Rotational Osteotomy for metacarpal malunion, needs to perform two symmetric cuts to create a middle segment of the bone. The length of the segment is to be at least three screw diameters for secured fixation with an additional fixation screw in the middle segment. The middle segment is rotated through an axis of 180 degrees and fixed dorsally with plate and screws. The operation involved small bone and high precision of cuts.

In the past, devices have been proposed for aligning bones and measuring cutting angles to correct deformities. For example, U.S. Pat. No. 4,335,715 shows a pair of guide blocks are movable along a scale extends along an accurate track of a substantially constant radius which indicates the angle of orientation of the pins inserted into the bone with respect to each other. The pair of pins serves as a guide for cutting.

U.S. Pat. No. 5,540,695 shows a cutting guide using an angle cutting block which is removably and adjustably attached to a stabilized base.

U.S. Pat. No. 5,601,565 shows a saw guide which establishes a cut plane and guides a cutting device as it cuts through the bone in the cut plane. The proper correction is done by choosing appropriate landmarks.

U.S. Pat. No. 5,645,548 shows an osteotomy frame for aligning first and second bone portions using a pair of clamps.

The above named osteotomy guides are unable to perform guiding for more than one angled cut and alignment of the bone pieces in a single step operation. Thus the success of the outcome of surgery is more dependent on the surgeon's experience, and also causes extensive tissue dissection.

The jig we have designed addresses this problem in enabling the osteotomy cuts to be done with the jig attached to the bone in a single step.

This jig also enables the user to perform precise angle measurement and positional accuracy so that the two cuts would be mirror image of the other in Rhomboid Rotational Osteotomy.

The principle objective of this invention is to provide a jig for secured and precise angular adjustment during the osteotomy.

A second objective of this invention is to provide a stable osteotomy guide that holds the cutting saw blade parallel to the angled guide.

The other objectives of this invention include precise positioning and displacement of the guide for cutting, and to provide fast and easy locking and secured mechanisms for angular and displacement adjustment.

SUMMARY OF THE INVENTION

This invention consists of a jig with 5 axes of movement and allows accurate measurement of cutting angles in two orthogonal planes and precise linear displacement parallel to a normal straight bone. Osteotomy blade is guided through a slot having a width and depth such that the blade is parallel to the angle measured and the blade could reach the bone in sufficient distance to complete a clean cut in a single step.

The guiding slot is held in position similar to a cantilever crank. A cylindrical bar with adequate length for transverse motion and first angle measurement is translating and rotating in a body and secured by a cam lock mechanism. The first angle measurement corresponds to the correction of deformity performed in anterior-posterior view. The second angle measurement for correction of deformity performed in lateral view is measured through an attachment which is hinged orthogonally to the cylindrical bar and secured in place by another fast locking mechanism. This attachment connects the cutting slot and body such that the slot is allowed to move linearly closer and away from the bone during operation.

The body provides stability for cutting. Its design, shape and materials allow it to withstand the forces induced during surgery. The body together with the cylindrical bar and other attachments slides on a base by rotating about a stud hidden in between the body and the base which is driven by a handle crank.

Alignment guides are modeled in different sizes to suit different bone length. This guide is attached to the base and aligns the axis of movement of the body with the bone through out the operation. The alignment guide with two prongs extended out from the base and two holes at the front with width and depth such that the alignment pin, which is normally the K-wires, is parallel to the guide drilled into the bone for secured alignment. The alignment guide is easily detachable for correction later.

The present method of carrying out the osteotomy involves the setting of predetermined cutting angles and alignment to the bone with K-wires. The first cut is then made at an anatomical landmark. The second cut can be performed immediately after readjusting the cutting angles and translating the body to a second anatomical landmark. The distance traveled between the two anatomical landmarks can be directly visualized and measured from the display attached on the rotating crank and stud mechanism. By choosing an appropriate landmark and alignment guide, the cut will be very accurate and results in proper correction of deformities.

Other objectives, features and advantages of the present invention will emerge from the following description of specific embodiments of the invention given with reference to the appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

- FIG. 1 shows a perspective view of the jig of the present invention.
- FIG. 2 shows an exploded perspective view of the jig of the present invention.
- FIG. 3 shows the components of shaft assembly with the cutting slot and fast locking cam.
- FIG. 4 shows the perspective view of a few K-wires guide in different sizes.
- FIG. 5 shows the locked position of the cutting guide in desired angles for two plane deformities.
- FIG. 6 shows the front view of suggested operating position with the oscillating cutting saw.

DETAILED DESCRIPTION OF THE INVENTION

Referring now in more detail to the drawings in which like numerals indicate like parts throughout the several views, the invention as a whole is shown in **FIG 1**. The invention consists of five axes of movement which allows adjustment of three linear distance and two angles. The purpose of the invention is therefore to align the bone and perform guiding to the requirement of precise cutting by the surgeon using a conventional pneumatic osteotomy oscillating saw.

FIG 2 illustrates the osteotomy guide **10** which includes a body **11**, a base **12**, an alignment guide **14** and a shaft assembly **15**. The base **12** is in rectangular shape with adequate footprint to provide stability and rigidity to the whole invention during the osteotomy. The full assembled osteotomy guide **10** will be placed on the surgical table directly such that the base **12** is at the same level as the hand of the patient throughout the whole operation.

The body **11** is to slide on the top surface of the base **12** using a stud **17** mechanism hidden inside. The surgeon could control the left and right movement of the body **11** by turning the crank **13**. The screw threads on the stud **17** shall match the movement compatibility such that the body **11** is moving to the right while the crank **13** is rotating in the clockwise direction and vice versa. The crank **13** is designed with adequate radius of rotation for ease of turning. The pitch of the stud **17** is to achieve the optimum speed of the sliding body **11**. The body **11** has a bore **16** for holding the shaft assembly **15** and secured with a cam lock **18**. Diameter of the bore **16** is such to allow smooth sliding and rotation of the shaft without vibration during osteotomy. The cam lock **18** is designed for both left and right-handed surgeon to fast lock and unlock the shaft once the angle is set by referring to the α -scale **20**. The cam lock **18** is in freely unlocking position while the handle **19** is standing straight.

FIG 3 shows the components of the shaft assembly with the cutting slot **36** and fast locking cam **31**. The angular adjustment is done by referring to the β -scale **40** printed on the front end of the cylindrical bar **30** and frictionally engaged by the cam lock **31**. The invention is capable of assisting a three dimensional deformity by setting two cutting angles in each of the two orthogonal planes.

The cutting slot **36** is defined by two symmetrical prongs with adequate width, height and length to allow the saw blade to pass through while automatically aligned to the angles dialed. The saw blade will just fit inside the slot **36** such that it will not twist or rock during cutting. A shorter bar **34** to guide the slot to move up and down is secured using a manual set screw onto the shaft assembly **15**.

Alignment guide is essential to ensure accuracy of cutting angles. Different sizes of alignment guides, as shown in **FIG 4**, might be needed to suit different sizes of hand and bone length. The alignment guides are easy to fit onto the base **12** and remove upon cutting. Two holes on each prongs of the alignment guide are for the passage of a pin which will be drilled into the bone to secure the alignment. The tip of the pin used is sharp and has a shape suitable for drilling into the bone surface. Normally K-wires should be used. The alignment guide holes are sized such to allow smooth yet straight guide to the wires. All the materials used should be corrosion resistant and can be sterilized if not disposable.

The suggested operation procedure will be first to expose the bone. Second, align the invention with the deformed bone that is intended for correction. Third, insert pins into the bone to secure the alignment. Then set the required angles of correction and lock, see **FIG 5** and **FIG 6**. After that, place the slot closer to the bone at the right anatomical landmark and perform the first cut. The angles can be reset to another requirement if a second cut is needed at the next anatomical landmark. Upon completion of cutting, the portable alignment guide should be removed and deformities can be corrected by the surgeon with proper fixation.

OSTEOTOMY JIG

CLAIMS

What is claimed is:

1. An osteotomy jig for guiding an osteotomy blade during cutting of bone, comprising:
 - (a) a slot sized such that the saw blade can be aligned to the angles and landmark required for cutting without twist and rock during cutting;
 - (b) two fast locking cam mechanisms to secure the two required angles to guide the saw blade in the required plane of cut;
 - (c) an alignment guide to secure the bone relatively to the base of the jig throughout the cutting operation and maintaining its rigidity; and,
 - (d) a body, with a bore for passage of the shaft assembly that holds the cutting slot, slides on the stable base to allow good transition after one cut to another.
 - (e) two standard angular scales to allow accurate angle adjustment which could form a stable guide in any possible plane of cut required.
2. The osteotomy jig is able to assist the correction of three-dimensional deformities by having two angular adjustments in two orthogonal planes.
3. The jig is best used for metacarpal malunion and yet will be useful for other long bone osteotomy.
4. The jig could perform single and multi-angled cuts in single operation with secured alignment.
5. The jig ensures reproducible results of osteotomy by minimizing human errors such as parallax error and hand giggling.