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(54) Title: FRACTURE REDUCTION APPARATUS

(57) Abstract: An apparatus for reducing a fracture in the lower arm of a patient, comprising securing means for restraining the upper arm of the patient, means for supporting the lower arm generally at right angles to the upper arm, and generally horizontal, means for applying a traction force of from 40N to 110N to the lower arm to reduce the fracture, wherein the means for applying a traction force includes attachment means capable of being secured to the hand to transmit the traction force to the lower arm.
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
Fracture Reduction Apparatus

This invention relates to the field of so-called "fracture reduction apparatus", that is apparatus for realigning a fractured bone into its correct position. In particular, the invention relates to apparatus for the reduction of displaced fractures of the wrist.

When a wrist is broken, it is not uncommon for the fracture to become displaced, i.e. the two parts of the bone become moved relative to each other. If the two parts of the bone remain displaced, the bone will not heal properly. It is therefore necessary to reduce the fracture, so that the bone parts are no longer displaced. Commonly, the fracture is reduced by manual manipulation, i.e. a doctor or nurse pulling on the hand of the patient to move the parts of the bone relative to one another, usually whilst a second doctor or nurse holds onto the upper arm of the patient. This is a painful procedure which commonly requires the patient to be anaesthetised prior to the procedure. A further disadvantage is that pulling the hand is a very imprecise way of ensuring that the fracture is reduced, as the doctor cannot accurately regulate the traction force which he applies to the fracture.

An alternative procedure involves an operation to physically move the parts of the bone into position, followed by a pinning of the two parts together. This involves the skin being cut to allow access to the bones, and is known as open reduction.

Various types of mechanical apparatus have been proposed for use in reducing fractures of the wrist. In general, such devices are designed for use in an operating theatre, and cannot, because of their size and complexity be used in other hospital areas, such as accident and emergency departments.
It is therefore desirable to produce a simple apparatus for wrist fracture reduction, which can be used in other hospital areas, for example when the patient is on a hospital trolley or an ordinary hospital bed, in an accident and emergency department.

In a first aspect of the present invention, there is provided apparatus for reducing a fracture in the lower arm of a patient, comprising:
securing means for restraining the upper arm of the patient;
means for supporting the lower arm generally at right angles to the upper arm, and generally horizontal;
means for applying a traction force of from 40N to 110N to the lower arm to reduce the fracture, wherein the means for applying a traction force includes attachment means capable of being secured to the hand to transmit the traction force to the lower arm.

This apparatus has a number of benefits. First, by having the lower arm at right angles to the upper arm, the lower arm is generally aligned along the side of the bed. This has the benefit that the trolley, having a patient with an arm under tension, can be moved easily around the hospital, for example to an X-ray or a plaster clinic without the need to move the arm or remove the traction force.

In addition, because the lower arm is at right angles to the upper arm, the traction force which is applied to the lower arm is not applied to the shoulder region. The application of a traction force to the shoulder region could cause dislocation of the shoulder joint, particularly in elderly patients.
In a preferred embodiment of the invention, the apparatus additionally comprises means for supporting an X-ray detector. The provision of an X-ray detector allows the lower arm to be X-rayed whilst the arm is under traction to enable a clinician to establish whether reduction of the fracture has occurred. This means that an arm can be placed in traction, then X-rayed and set whilst the arm remains in traction throughout.

The means for applying a traction force may be a set of weights for applying a variable traction force to the lower arm by virtue of their weight, and transmission means, for example a rope, for transmitting the force produced by the set of weights to the lower arm. As the number of weights used can be varied, it is possible to choose the correct traction force which must be applied in order to reduce the fracture.

The force is transmitted to the arm via the attachment means which preferably include at least one finger trap. However, it is more preferable that the attachment means is made up of a number of finger traps which are attached to a spreader bar. The use of a spreader bar ensures that the fingers traps are sufficiently well spread to receive the fingers and/or thumb and allow the tension to be evenly distributed across all of the attached digits.

In an alternative embodiment, the traction force is produce by a variable tension spring. The spring can be adjusted to produce different forces, depending on the amount of force needed to reduce the fracture.

The amount of traction force to be applied to the arm of a patient depends both on the patient, and also on the severity of the fracture. Preferably the amount of traction force to be applied is from 65N to 80N.
In a second aspect of the present invention, there is provided a kit of parts for assembly into an apparatus for reducing a fracture in the lower arm of a patient, comprising:

a) a first part including securing means for restraining the upper arm of the patient;
b) a second part including means for applying a traction force of from 40N to 110N to the lower arm to reduce the fracture;
c) means for supporting the lower arm generally at right angles to the upper arm, and generally horizontal; and
d) means for securing the said first and second parts, in use, to a patient support, wherein the means for applying a traction force includes attachment means capable of being secured to the hand to transmit the traction force to the lower arm.

It is preferred that the first part additionally includes the means for supporting the lower arm.

The kit of parts has the benefit that it can be easily assembled and attached to a hospital trolley or a hospital bed. It can also be easily disassembled and stored away.

Preferred embodiments of the invention will be further described with reference to the accompanying drawings in which:-

Figure 1 shows the fracture reduction apparatus
Figure 2 shows the apparatus in position on a trolley
Figure 3 shows a bracket holding an X-ray plate.

The fracture reduction apparatus shown in Figure 1 has a first support column (1) which is supported by a bracket (5) for attaching the support column (1) to a hospital trolley. Attached to the top of the support column is a support (10) for the upper arm and a support (15) for the lower arm. The
support column (1) is adjustably connected to the bracket (5) so that when the bracket (5) is connected to a trolley, the height of the upper arm support (10) and the lower arm support (15) can be adjusted by movement of the support column (1).

The upper arm support (10) has a restraining strap (20), for securing the upper arm of a patient to the upper arm support (20). The upper arm support (10) is adjustable, so that the restraining strap (20) can be moved relative to the lower arm support (15), to take account of differing arm sizes. The upper arm support (10) and the lower arm support (15) are positioned relative to each other such that when a patient’s upper arm is in position on the upper arm support (10), the elbow must be bent to an approximate right angle so that the lower arm can rest on the lower arm support (15). When in position, the lower arm is generally horizontal.

The apparatus also consists of a second support column (30), which is supported by a bracket (35) for attaching the support column (30) to the hospital trolley. Attached to the top of the support column (30) is a pulley (40). The support column (30) is adjustably connected to the bracket (35) so that when the bracket (35) is connected to a trolley, the height of the pulley (40) can be adjusted.

A rope (50) is provided for attaching at a free first end to a weight holder (55) for receiving weights (60). The other end of the rope (50) is connected to a metal bar (65), having a number of holes (68). Further ropes (70, 72, 74) are threaded through three of the holes (68) and securely fastened. The other end of the ropes (70, 72, 74) are connected to "finger traps" (80, 82, 84). A finger trap is a hollow tube which reduces in diameter as it is pulled lengthwise. Therefore, once in position over a finger, the application of a force
along the length of the finger trap serves to hold the trap tighter on the finger.

As shown in Figure 2, the first support column (1) is clamped to the trolley by bracket (5) so that the support column (1) is positioned near the "head" end of the trolley. The height of the upper arm support (10) and the lower arm support (15) can be adjusted so that they are the correct height for a patient to rest his/her arm on.

The second support column (30) is clamped to the same side of the trolley as the first support column (1), closer to the "feet" end. The height of the pulley (40) is adjusted so that it is approximately the same as the lower arm support (15). The finger traps (80, 82, 84) are positioned on the thumb, index finger and middle finger of the patient. The rope (50) is passed over the pulley, so that the free end of the rope hangs down. The weight holder (55) is attached to the free end of the rope (50) such that the weight holder (55) does not touch the floor. A suitable number of weights (60) are applied to the weight holder so as to apply tension to the rope (50) and thereby to the lower arm of the patient. As the upper arm is secured in place by the restraining strap (20), the force of the weight acts to stretch the lower arm and reduce the fracture.

In a further preferred embodiment, as shown in Figure 3, the apparatus additionally comprises a third support column (90), which is supported by a bracket (95). The third support column holds an X-ray plate (100), which is adjustable so that when the bracket (95) is attached to a trolley, the X-ray plate can be positioned underneath or adjacent to the lower arm of a patient, allowing an X-ray to be taken from a number of angles.
The upper arm of the patient is positioned in the upper arm support (10), and the upper arm is strapped in place by the restraining strap (20). The elbow is bent to an approximate right angle, and the lower arm is positioned on the lower arm support (15).

This system is advantageous in that it requires the involvement of only one nurse, rather than the two or three nurses as are often currently required to reduce a fracture.

In at least the preferred embodiment, the fracture can be X-rayed whilst the arm is under traction. Additionally, the fracture can be plastered whilst the arm is under traction, so that the bones cannot move after reduction.

The procedure is less painful to the patient than most reduction techniques currently employed, and therefore is less likely to require anaesthesia.

Additionally, the simplicity of the apparatus of the preferred embodiment allows it to be attached quickly and easily to a trolley, and the arm of the patient can be put under traction as soon as an assessment is made by a doctor that reduction of the fracture is required.

A further advantage of the apparatus is the mobility of the bed or trolley with the apparatus attached, which permits the patient to be moved around the hospital without difficulty.

As the preferred apparatus consists of a number of separate parts, which are all detachable from the bed or trolley, the apparatus can be packed away conveniently for storage.
**Claims**

1. An apparatus for reducing a fracture in the lower arm of a patient, comprising:
   - securing means for restraining the upper arm of the patient;
   - means for supporting the lower arm generally at right angles to the upper arm, and generally horizontal;
   - means for applying a traction force of from 40N to 110N to the lower arm to reduce the fracture, wherein the means for applying a traction force includes attachment means capable of being secured to the hand to transmit the traction force to the lower arm.

2. An apparatus as claimed in claim 1, wherein the apparatus additionally comprises means for supporting an X-ray detector for allowing the lower arm to be X-rayed whilst the lower arm is under traction force.

3. An apparatus as claimed in claim 1 or claim 2, wherein the means for applying a traction force comprises:
   - a set of weights for applying the traction force to the lower arm by virtue of the weight of the set of weights; and
   - transmission means for transmitting the force produced by the weight via the attachment means to the lower arm.

4. An apparatus as claimed in any one of the preceding claims, wherein the attachment means comprise at least one finger trap for attaching to a finger or thumb of the patient.

5. An apparatus as claimed in claim 4, wherein the attachment means comprises a plurality of finger traps.
attached to a spreader bar for positioning the finger traps to receive the fingers and/or thumb.

6. An apparatus as claimed in any one of the preceding claims, wherein the means for applying the traction force is for applying a traction force of from 65N to 80N.

7. A kit of parts for assembly into an apparatus for reducing a fracture in the lower arm of a patient, comprising:
   a) a first part including securing means for restraining the upper arm of the patient;
   b) a second part including means for applying a traction force of from 40N to 110N to the lower arm to reduce the fracture;
   c) means for supporting the lower arm generally at right angles to the upper arm, and generally horizontal; and
   d) means for securing the said first and second parts, in use, to a patient support, wherein the means for applying a traction force includes attachment means capable of being secured to the hand to transmit the traction force to the lower arm.

8. A kit of parts as claimed in claim 7, wherein the first part includes the means for supporting the lower arm.

9. An apparatus substantially as hereinbefore described with reference to and as illustrated by the drawings.