Extracortical Clamp Device

Extracortical clamp devices (ECD) is a special devise designed for fixation of bone fragment to support of external fixation device without necessity to perforate the cortical layer and bone cavity (as it's necessary while using wires and half-pins).

Indications for application of ECDs

- Type B1 and C periprosthetic femur according to Vancouver classification;
- Periprosthetic deformities;
- Massive foreign body in bone cavity (spacer, nail);
- Infection in bone cavity

What ECDs are necessary for?

Usage of plating techniques for periprosthetic fractures has a number of serious disadvantages. A bone fragment, already deprived of intramedullary blood supply, now is being partially deprived of the periosteal circulation as well – or its volume, with plate constructions used, is substantially diminished. Besides, rigidity of plate osteosynthesis and therefore effectiveness of functional treatment depends directly upon the size of a plate being used - and larger plate implies more extensive operative trauma. As far as revision arthroplasty with a long stem of endoprosthesis goes, it is not efficient for treatment of Vancouver type B1 and type C fractures.

Traditional external fixation techniques may in such situations be only used limitedly - because presence of a foreign body in the intramedullary cavity precludes regular ex-fix elements like wires and half-pins to be inserted through the bone (Shersher Ja.I. et. al, 1986 ; Oganesjan O.V. et al., 2004; Volokitina E.A., 2008). But it looks prospective more widely to use such advantages of external fixation as low invasiveness, opportunity of closed reduction and rigid fixation of bone fragments.

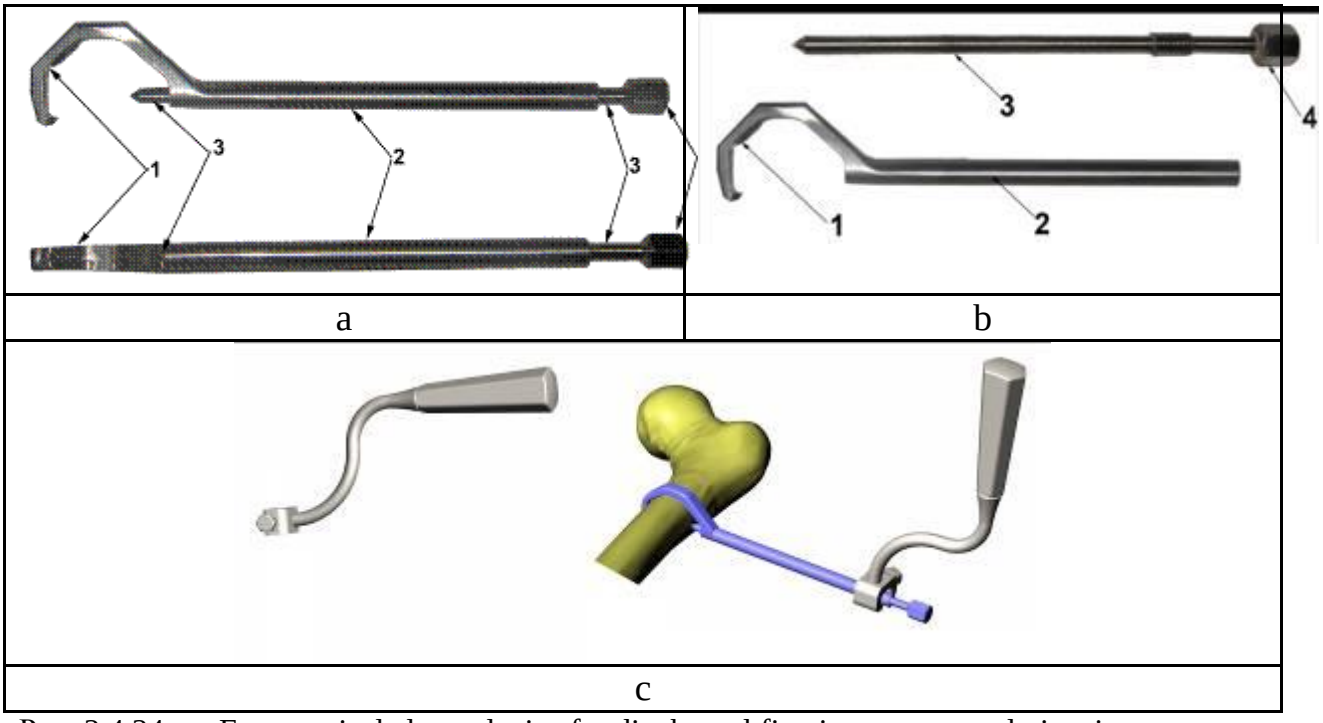
Alternatively, extracortical clamp devices (ECD) may be used for treatment of periprosthesis fractures. EFC is a special devise designed for fixation of bone fragments with a massive foreign body inside - a nail, stem of a joint prosthesis etc.- to the support of external fixation device.

ECD's design

There are two variants of ECDs: for diaphyseal fixation (fig.1) and supracondylar fixation (fig.2). ECD for supracondylar fixation can be used also at diaphysis, for example, in cases of osteoporosis.

Extracortical clamp device consists of two main parts: submersible, or inside part serves to provide a contact between fixator and the bone, and the outside part connects to basic support of the frame. The inside part has one or two hook-shaped

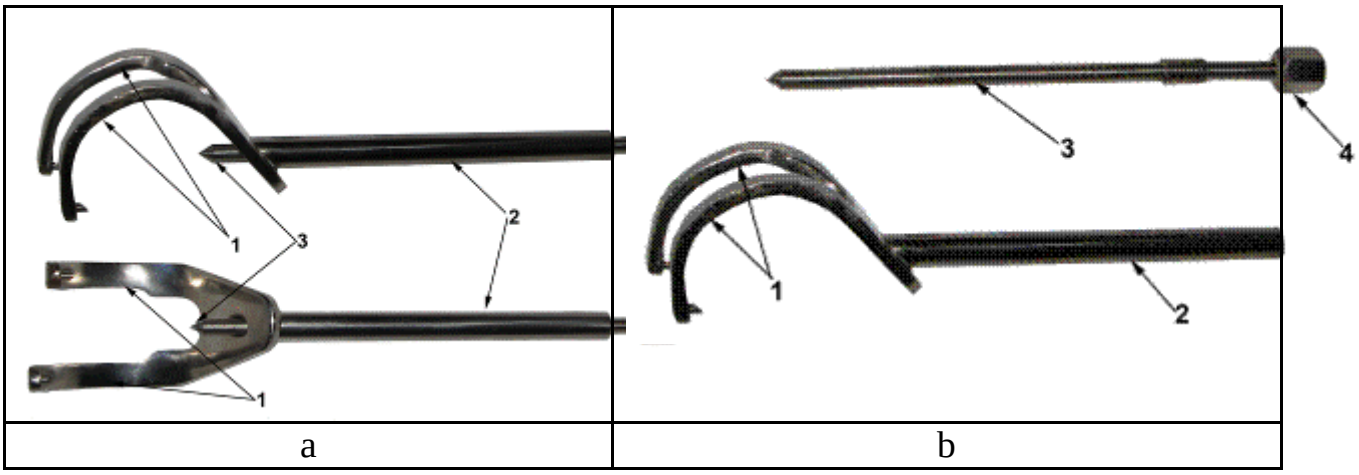
tabs (1) each encompassing more than a semicircumference of bone fragment. Tabs are equipped with chisel teeth. Through their base these tabs are connected rigidly to the tail piece (2). The tail piece (clamp's outside part) represents an internally threaded hollow rod. A pointed rod (3) - equipped at the base by wrench head (4) - is screwed into the hollow rod. Spatial positioning of a pointed pressing rod (eccentrically relatively to the tab's axe) - as well as the way tab's chisel teeth are shaped and placed - ensure a fixation rigid enough.



a b

c

Рис. 2.4.24a-c. Extracortical clamp device for diaphyseal fixation. a – general view in two planes. b – fixator disassembled: 1 – hook-shaped tab, 2 – tail-piece, 3 – pointed clamping rod, 4 - wrench head. c – fixator's mounting handle: separately and as fixed to the extracortical clamp device



a b

Рис. 2.4.25a-c. Extracortical clamp device for supracondylar fixation. a – general two plane's view. b – fixator disassembled: 1 – hook-shaped tab, 2 – tail-piece, 3 – pointed clamping rod, 4 - wrench head

Application technique

Placement of ECD is chosen checking with an X-ray shot and "Reference Positions for the insertion of transosseous elements" (http://rniito.org/solomin/download/atlas-engl.zip). The ECD dimension type (sizes of tabs and the tail-piece) has to be selected. Next step is to connect ECD with the mounting handle, as fig. 1c shows.

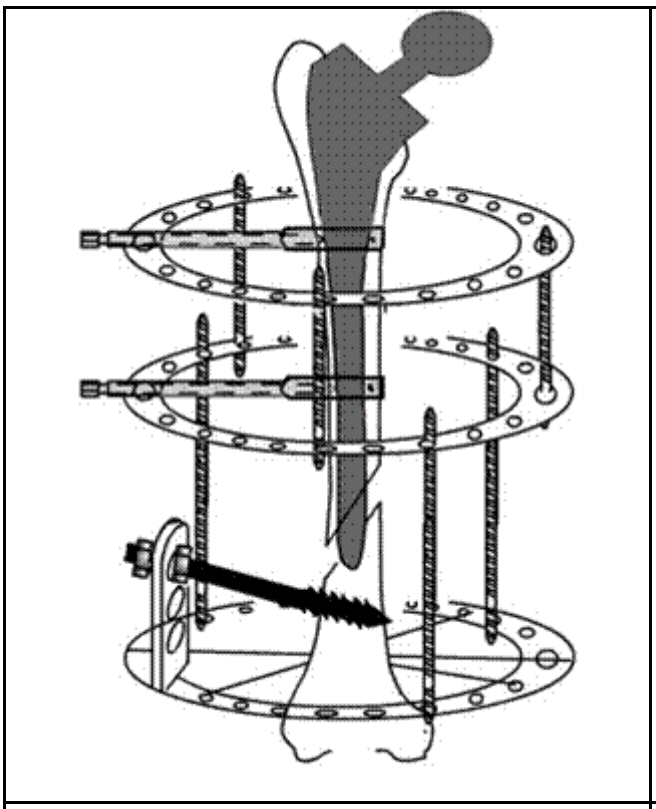
Then in aseptic conditions, through longitudinal 2-2.5 cm insision (if a diaphyseal fixation clamp is used) or 3-4 cm incision (if a supracondylar fixation clamp is used), soft tissues are splitted by a slit-like canal up to the bone. Using narrow curved raspator, the bone area intended for the fixation of ECD is disengaged from the soft tissues. If this step is omitted, tabs of the clamp will hold muscles and there will be no rigid bone-metal adhesion.

The "submersive" part of ECD is inserted into the canal. Using mounting handle as a joystick, this inside part is oriented in such a way, so as to achieve contact between the bone and the inner surface of tabs. To insert a diaphyseal fixator, it is recommended to position the plain surface of a tab frontally (parallel to long axe of the bone). When the tab reaches the point where it is just above the bone central axe, fixator is turned on the right angle using a mounting handle. After that pointed rod is being screwed until it places itself against the bone. The screwing continues until the bone is firmly grasped by tab (tabs) from one side and the rod pointer – from the other. In the process of screwing it is necessary to press the concave part of the tab to bone. Mounting handle is removed and the tail-piece is fastened to the frame's external support by an L-shaped fixator.

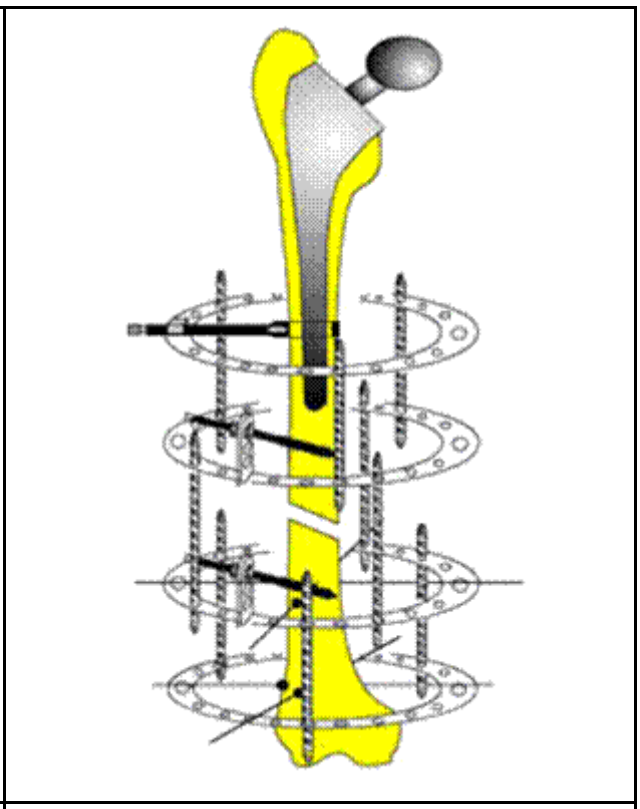
How many ECDs are necessary for stable fixation of bone fragments?

The fragment containing hip component of the endoprosthesis is fixed using two ECDs adjusted to basic supports. If it is possible to insert transosseous elements below the stem of endoprosthesis (type C fractures), one ECD and two traditional transosseous elements (wires, half-pins) are inserted.

Second bone fragment - if there is a foreign body present inside of its medullar cavity - is to be fixed by one or two extracortical clamps. If there is no foreign body inside of a fragment, it is fixed by wires or half-pins, and the latter, in turn, are fastened to the frame's external support(s) (fig. 3 and 4). Using external fixation techniques, fracture is being reduced. Fragments are stabilized by an external fixation devise until consolidation is achieved. During consolidation period it is necessary to stabilize EDC continuously by screwing the pointed rod at 0,5-1 мм every week.



a



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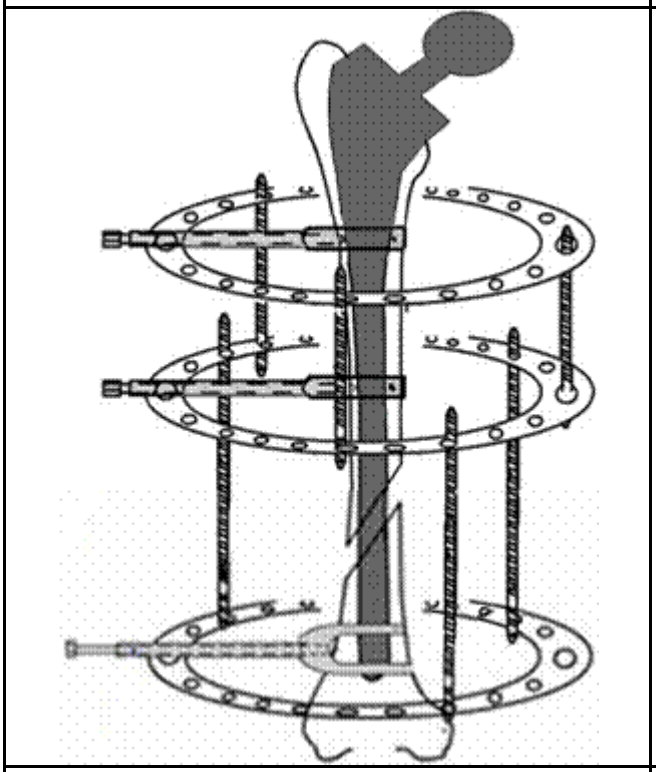
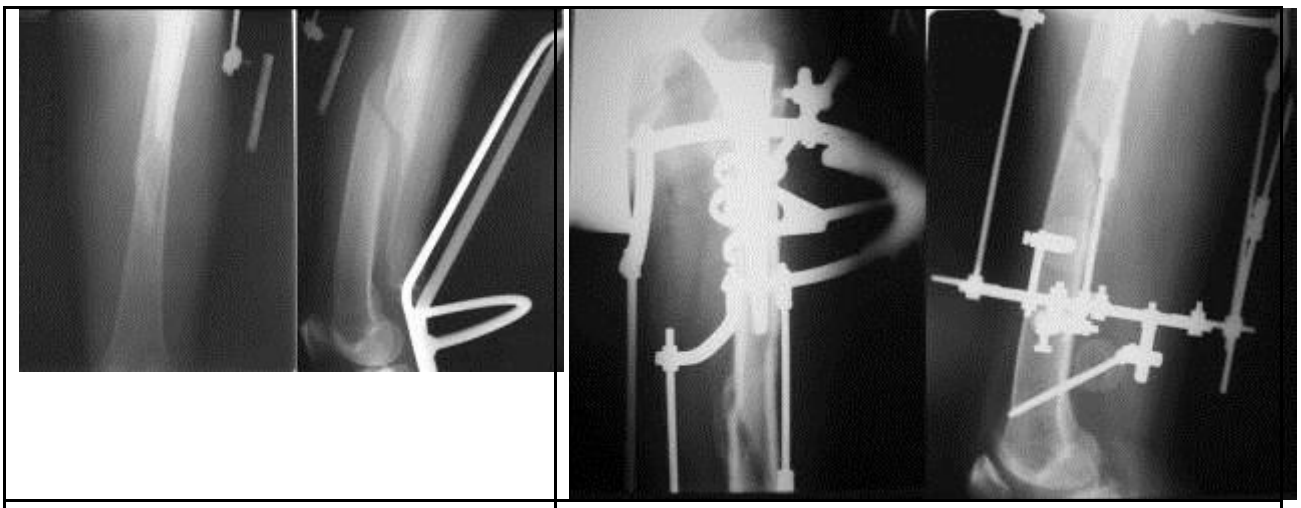


c

Fig 3a-c. Variants of ECD application for treatment of periprosthetic fractures.

Clinical case of ECDs application in periprosthetic fracture



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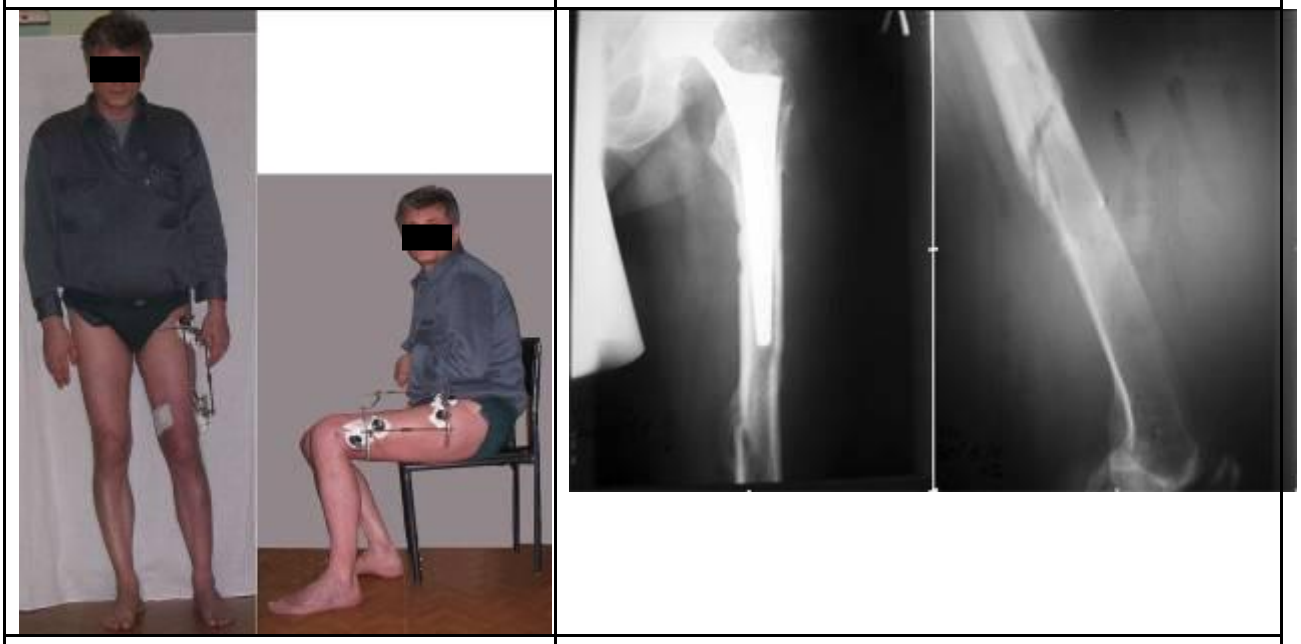

c d

e

Рис. 4 a-e. ECD application for treatment of periprosthetic fracture

Other indications for application of ECDs

Apart from the treatment of periprosthetic fractures, extracortical clamp devices may be used in other situations - whenever external fixation is indicated, but there are limits to inserting of wires and half-pins (fig. 5-9).

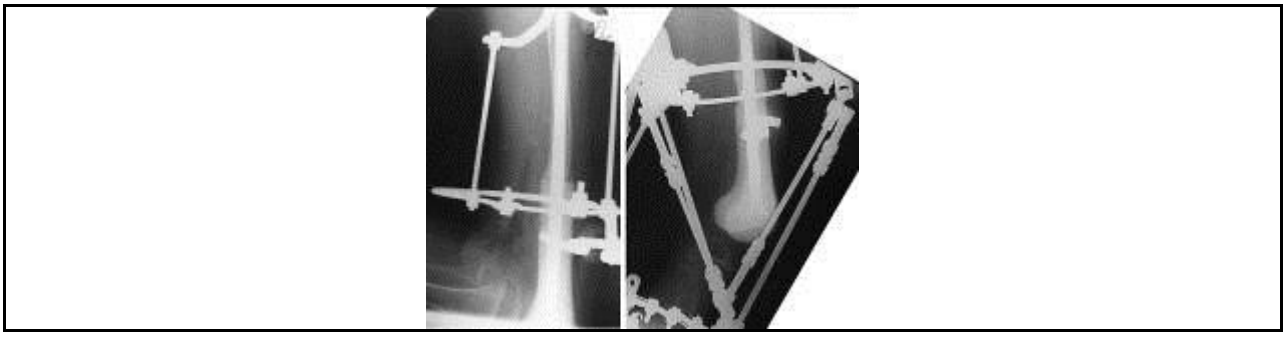

Fig. 5. Upon placement of oncological knee joint prosthesis, the persistent faulty position of the lower leg was formed: flexion with posterior subluxation. By using Ortho-SUV device with ECD as one of its components, the wrong position has been gradually corrected

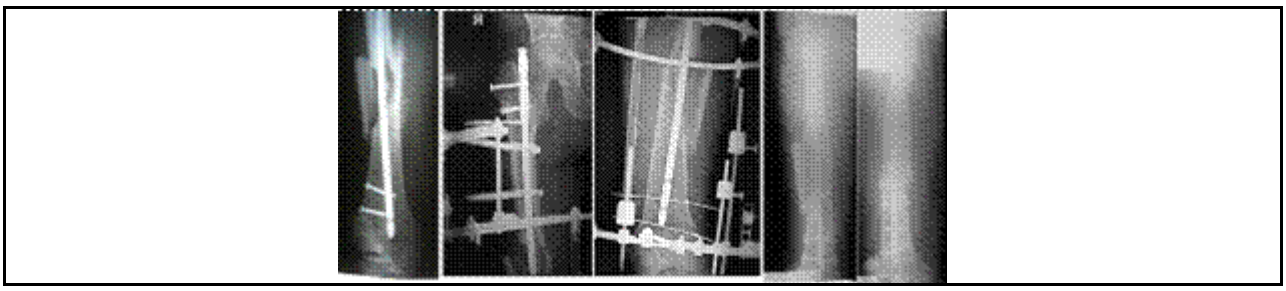

Fig. 6. Nailing failure caused fragments to be displaced for the second time (shortening 5 cm, outside rotation 55 degrees). After unlocking of the nail the Ilizarov frame has been applied. Fragment's displacement has been corrected gradually. Nail is locked back and the frame is removed

Fig. 7. Application of ECD in treatment of osteomyelitis enables to firmly stabilize bony fragments and insert spacer with antibiotics into intramedullary cavity

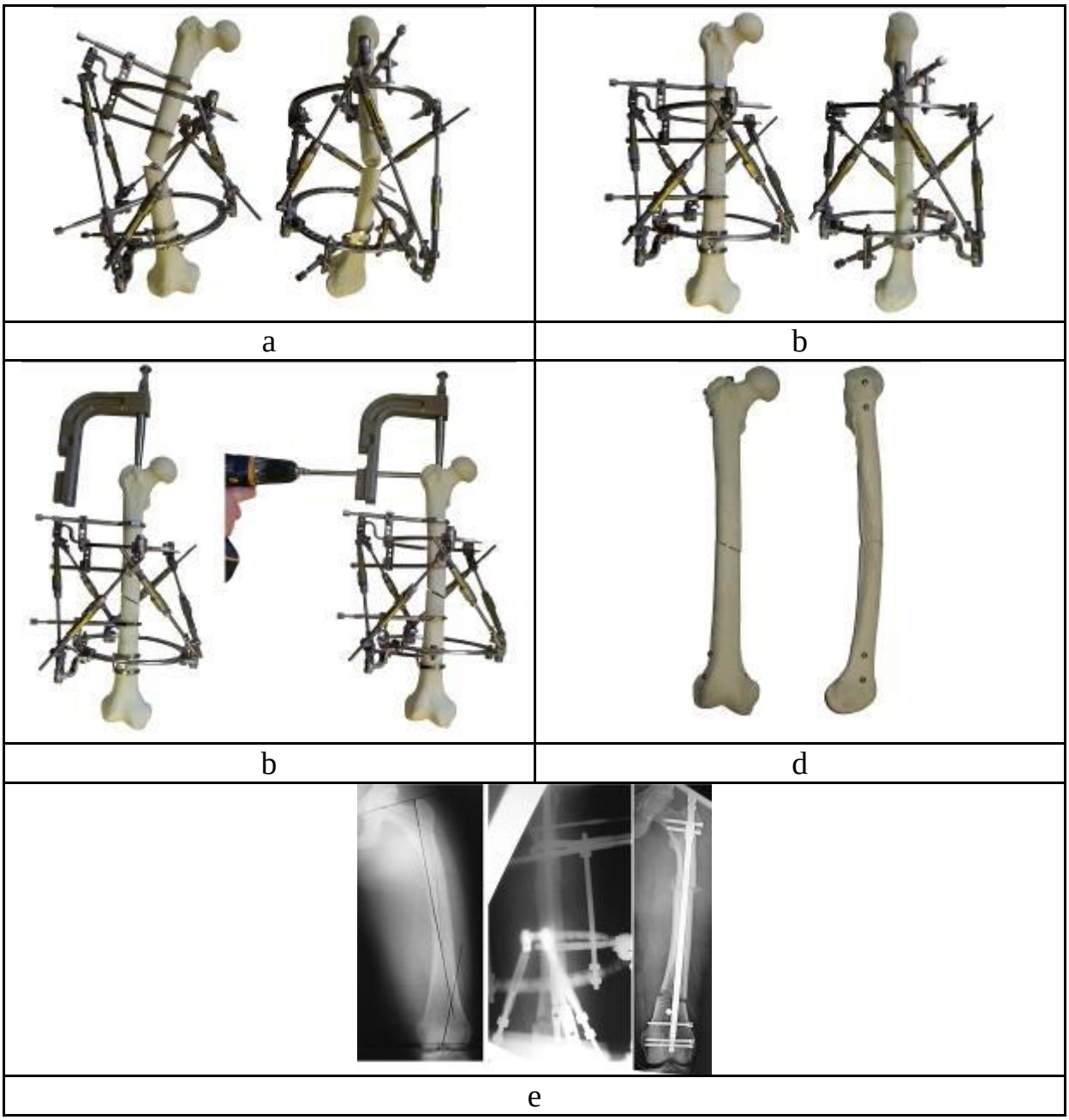

Fig. 8a-e. Deformity correction using ECD. a-d - step-by-step correction with Ortho-SUV Frame. e – acute deformity correction

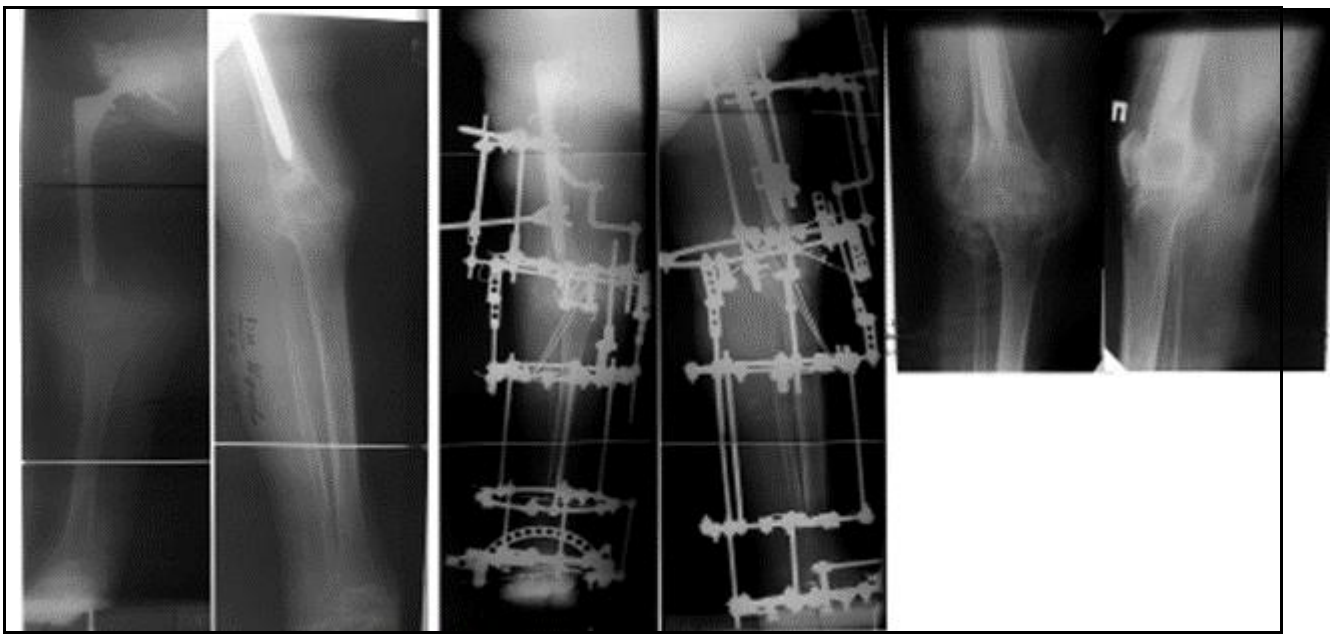

Fig. 9. Clinical example of ECD application as a part of arthrodesis in a female patient with deforming 3-d stage arthrosis of right knee joint and a history of earlier revision hip arthroplasty with a femoral component “Vagner”