Biomechanical Aspect of AO Internal Technique & External Fixation modified by I. Pichkhadze 2020

Different treatment concepts of fractures M. Wagner's

Mechanical stability

As – "Absolute" stability - the mobility is less than 0.1 mm / 1^0 in the fracture zone

As – "Absolute" stability during the stabilization phase

Rs – Relative stability

Method and range of functionality

3D-s – Spatial stabilization is provided	No 3D-s – Spatial stabilization not provided	3D-pt - Tension controlled along the perimeter of the segment during the stretching phase	No 3D-s – Spatial stabilization not provided
DC - Directional (steerable) compression axis	C – Compression	D – Distraction	S – Splinting bridling

Technique, principle and implants

DC - Directional (steerable) compression axis	C – Compression		D – Distraction	S – Splinting bridling	
S-DC- Static, with control of the axis of direction of the compression forces 1A In the damaged segment, a high degree of stability is ensured in the fracture zone with a uniform distribution of load forces around the perimeter of the bone on each bone fragment, and in the external fixation device it is possible to adjust the load value and the direction of the axis - the vector of the compression forces (not only along the axis of the bone, but also perpendicular to the plane of the fracture), based on the "Biomechanical concept of fixation of fractures". This significantly improves the conditions for regeneration in the fracture zone.	S- Static 1B The fracture is compressed - the implant is stressed	D- Dynamic 2A Compression in conditions of function S- Static / D- Dynamic tension band	D- Dynamic 2B, – S- Static 1C 3D-pt – tension 3D-ps – stabilization TS – Tension – Stretching 2B The limb is stressed when: - Substitution in the defect zone - Lengthening	B- Blocking 3 Blocking splint with control a length, axis and rotation	Nb- No blocking 4 Splinting with limited control of length, axis and rotation
Lag Screw / Pin with Friction-Locking Head (LS / P-FLH) to the plate, not adjustable along the screw axis Friction Locked Head Lag Screw / Head Pin - to plate: 1. Press-in conical friction / spherical friction joint 2. Conical friction threaded connection Provides 3D stabilization, between the "attachment element" and the "carrier part of fixator", for example: screw head and plate, but does not provide compression in the required directions.	Lag screw Lag screw Neutralization Plate or Protection Plate Lag screw and protection plate (DCP, LC-DCP, LCP) Compression Plating Compression plate (DCP, LC-DCP, LCP)	Tension Band Principle Tension band Plate by the tension band principle (DCP, LC-DCP, LCP)	External fixator 1B External fixator Ilizarov & ect. - ring systems for long bones/ - non-ring systems for short bones Intra Medullary Nailing - Distractor & Compression (Intramedullary nail - distractor)	External splint 1C External fixator – non-ring systems, without even distribution of forces around the bone perimeter (AO & etc.) Intra Medullary Nailing Intramedullary splint (intramedullary nail)	External splint – conservative treatment (plaster cast, traction) Intra Medullary Nailing Intramedullary splint (elastic nail, Kirschner wire)
Lag Screw / Pin with Friction-Locking Head (LS / P-FLH) to the plate, - with adjustable fastening along the screw axis, to the bearing part of the fixator 3. Friction-Locked connection along the screw and (or) threaded pin for reduction and dosed compression in the required direction.					
Neutralization Plate or Protection Plate with an even distribution of forces on each bone fragment – without DC 1. Lag screw and protection plate (LCP) 2. Screw and / or Pin with frictional locking head (1, 2 types) and stabilizing arrangement of "Supra-osseous (Plate) -subcutaneous-external fixator" (at an angle of 60^0 - 90^0) – system by Pichkhadze, 1988.	Buttress Plate Buttress plate (DCP, LC-DCP, LCP)			Internal extramedullary splint Zone bypass break of standard plate (DCP, LC-DCP, LCP with standard screws) Zone bypass fracture block-able fixators (LISS, LCP, LHS)	
Supra-osseous - Subcutaneous - External osteosynthesis – system by Pichkhadze, 1988. with an adjustable screw and / or rod with locking attachment (3 types) and with an even distribution of forces on each bone fragment around the bone perimeter. Compressing Supra-osseous (Plate) - Subcutaneous & External Fixator - 1988, 1991 with fixation of screws at an angle of 60^0 - 90^0 (mini invasive technique). There is no need to expose the bone fragment along its entire length, in order to neutralize the properties characteristic of the lever of each fragment. The fixation can be done by the "outer part of the fixator", according to the principle of fixing the rods in the ExFix.	Compression Plating - Intra Medullary Bone Fixation Compression Plating - Intra Medullary Fixator by Pichkhadze 2001, etc.				
External fixator 1A External fixator - ring systems, + devices I -V mod. Pichkhadze with even (uniform) distribution of forces around the bone perimeter					

Reposition

Indirect – closed - controlled by calculations and from PC / Electromechanical
- independent in each plane of three-dimensional space – by devices I-V mod. by Pichkhadze

Direct - open

Direct – open
– Semi-open
Indirect – closed

Indirect - closed

Bone fusion

Direct - Primary

- (by no means all fixators and their arrangements, since the principles of the Biomechanical Concept of Fracture Fixation are not always provided)

Indirect – Secondary