ORTHOVERSE · HIGH-YIELD CARD

Plate and Screw Strain Lab

Interactive simulator
orthoverse.org/simulators/plate-strain-lab/

HIGH-YIELD

- Strain = interfragmentary motion ÷ gap; the same motion yields higher strain in a narrow than a wide gap
- Hard callus (bone) tolerates up to 2% strain; soft callus up to ~10–12.8%; hematoma up to ~100%
- Classic callus-forming range: 2–10%; optimal window 7–24%; bridging absent above 48%
- Primary healing requires anatomic reduction + compression + motion under 0.15 mm with no gap
- Secondary healing: relative stability, residual gap, callus predominantly on the cortex opposite the plate
- Stiff bridge + residual gap → atrophic nonunion; excessive motion → hypertrophic nonunion
- Axial stiffness falls with working length; longer working length increases flexibility and callus stimulus
- Highest plate strain is at the two holes beside the fracture; empty hole over fracture raises fatigue risk
- Locking screws act at fixed angle, fail in parallel; conventional screws fail one by one
- Titanium is approximately half as stiff as steel and may improve callus in bridge constructs

PITFALLS

- Non-anatomic reduction + rigid fixation = no compression and no callus stimulus; construct frequently fails
- Empty hole over the fracture site markedly increases plate fatigue failure risk
- Locking screws do not compress bone; compress first with a conventional screw or compression device before locking

NUMBERS TO KNOW

Hard callus (bone) strain limit	2%
Soft callus strain range	10–12.8%
Hematoma strain limit	~100%
Classic callus-forming range	2–10%
Optimal callus window (sheep study)	7–24%
Primary healing motion threshold	< 0.15 mm
Minimum cortices per fragment (Campbell)	6–8
No callus bridging above (sheep data)	48% strain

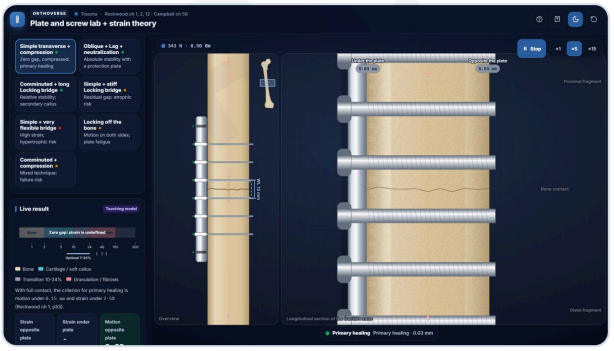


Figure. Simple fracture with compression: zero gap, absolute stability and primary bone healing.

FURTHER READING

Rockwood and Green's Fractures in Adults, 10th edition: ch 1, 2 and 12 (biomechanics, bone healing and principles of fracture fixation).
Campbell's Operative Orthopaedics, 15th edition (2026): ch 58 (general principles of fracture treatment).

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