

1 Primary bone healing	31
2 Secondary bone healing via callus formation	33
3 Steps of differentiation cascade	33
4 Nonunion	37
5 Delayed union	37

1.3.3 Biological reaction and healing of bone

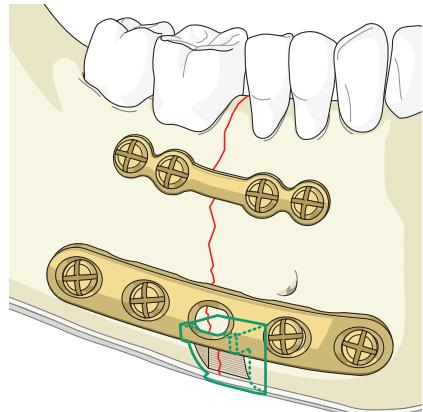
A sufficient blood supply, presence of specific cells, and adequate mechanical conditions are the prerequisites for undisturbed fracture healing. Fracture healing may occur under different degrees of interfragmentary motion, ranging from absolute immobilization of the fracture zone, ie, no opening and closing of the fracture plane under functional loading, to moderate excursions of fragment ends when no or nonstable fixation is performed. The range of motion, which is dependent on whether or not a fracture is treated, and in which way, determines the healing pattern. Dependent on the biological and biomechanical environment, three basic scenarios can be differentiated:

1. Primary bone healing (contact or gap healing)
2. Secondary bone healing via callus formation
3. No bone healing

1 Primary bone healing

In cases where interfragmentary motion can be completely avoided, a healing pattern results which is characterized by an increased amount of intracortical remodeling, inside and in between the fragment ends. Bony contact between the fragments is necessary to maintain stability. This is the case in compression osteosynthesis, buttressing conditions, or load-bearing osteosynthesis.

Contact areas and gap zones of different widths characterize the morphological situation between the fragment ends. In contact zones, the Haversian remodeling proceeds through the fracture plane. This leads to a direct bony bridging by a structure which is already mature bone and is oriented in the preinjury axial direction (**Fig 1.3.3-1a–b**). In the neigh-



a

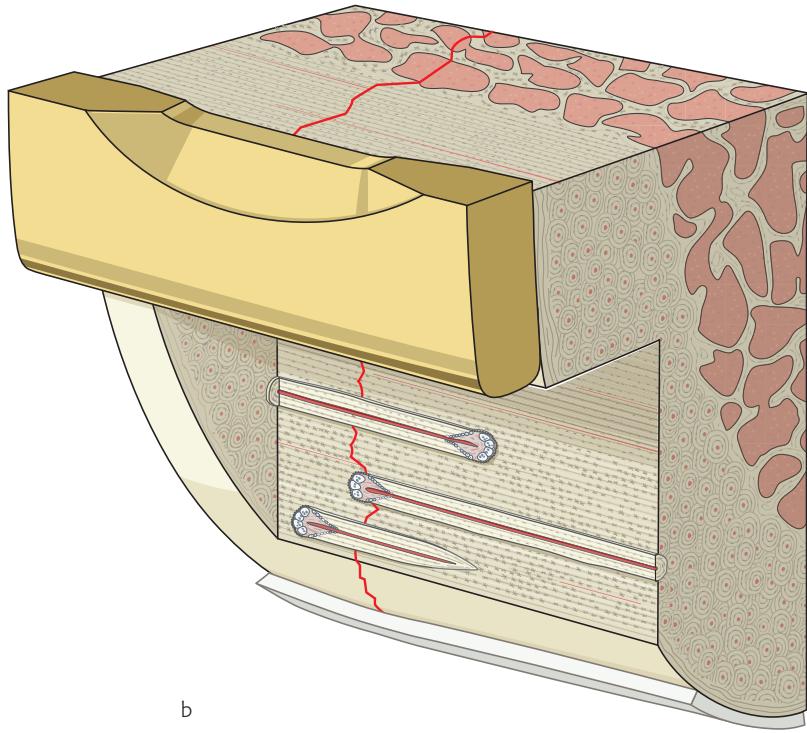


Fig 1.3.3-1a–b

- a** Functionally stable fixation of a mandibular fracture with excellent repositioning as a precondition for primary bone healing.
- b** Enlarged section of (a): primary bone healing contact area, direct bony bridging showing osteons crossing the fracture area.