CLAIMS

~~What is claimed is:~~

~~1. A medical device comprising:~~

~~a structure having a lumen extending at least partially therethrough, and configured to be at least partially implanted in a body; and~~

~~an electronics cartridge including electronics and configured to be inserted into the lumen after implant of the structure.~~

~~2. The medical device of claim 1, further comprising a sensor for measuring an electrical property of tissue, the sensor comprising:~~

~~a plurality of electrodes; and~~

~~a sensing module of the electronics cartridge, coupled to the plurality of electrodes.~~

~~3. The medical device of claim 2, wherein:~~

~~the plurality of electrodes comprise a first electrode and a second electrode; and~~

~~the sensing module is configured to enable the first electrode and the second electrode to function in either of an application mode during which a signal is applied across the electrodes, or a sensing mode during which an impedance between the electrodes is sensed.~~

~~4. The medical device of claim 3, wherein the sensing module comprises a signal generator configured to apply signals at different frequencies to measure tissue impedance in accordance with electrical impedance spectroscopy (EIS) techniques.~~

~~5. The medical device of claim 2, wherein:~~

~~the sensor further comprises an electrode switch;~~

~~the plurality of electrodes comprise a first electrode, a second electrode, a third electrode and a fourth electrode switchably coupled to the sensing module through the electrode switch; and~~

~~the sensing module is configured to enable an application mode during which a signal is applied across the first electrode and the second electrode, and to enable a sensing mode during which an impedance between the third electrode and the fourth electrode is sensed.~~

~~6. The medical device of claim 5, wherein the sensing module comprises a signal generator configured to apply signals at different frequencies to measure tissue impedance in accordance with electrical impedance spectroscopy (EIS) techniques.~~

~~7. The medical device of claim 2, wherein the electrical property of tissue comprises impedance measurements, and further comprising a controller configured to process impedance measurements over time to determine a characterization of a bone fracture, the characterization corresponding to a healing state of the bone fracture.~~

~~8. The medical device of claim 7, wherein the healing state corresponds to one of union, likely non-union, and non-union.~~

~~9. The medical device of claim 2, wherein:~~

~~the plurality of electrodes are associated with the structure and spaced apart to enable placement of a first electrode and a second electrode on opposite sides of a bone fracture; and~~

~~the electronics cartridge comprises a plurality of electrical contacts located to electrically couple with the plurality of electrodes when the electronics cartridge is inserted into the lumen of the structure.~~

~~10. The medical device of claim 2, wherein:~~

~~the plurality of electrodes are associated with the electronics cartridge and spaced apart to enable placement of a first electrode and a second electrode on opposite sides of a bone fracture.~~

~~11. The medical device of claim 10, wherein:~~

~~the structure comprises at least one aperture through a sidewall; and~~

~~the plurality of electrodes are positioned on the electronics cartridge to align with the at least one aperture when the electronics cartridge is inserted into the lumen of the structure.~~

~~12. The medical device of claim 10, wherein:~~

~~the structure comprises a distal end opening and a proximal end opening; and~~

~~the plurality of electrodes comprises a first electrode positioned on the electronics cartridge to be adjacent the distal end opening and a second electrode positioned on the electronics cartridge to be adjacent the proximal end opening when the electronics cartridge is inserted into the lumen of the structure.~~

~~13. The medical device of claim 10, wherein:~~

~~the structure comprises a distal end opening; and~~

~~the plurality of electrodes comprises a first electrode and a second electrode each positioned on the electronics cartridge to be located distal the distal end opening of the structure when the electronics cartridge is inserted into the lumen of the structure.~~

~~14. The medical device of claim 1, wherein the lumen is configured to receive an implant tool during implant of the structure.~~

~~15. The medical device of claim 14, wherein the structure comprises a head having a sunken pocket that define a head portion of the lumen that is configured to receive a part of the implant tool to enable a transfer of torque applied to the implant tool to the structure.~~

~~16. The medical device of claim 1, wherein the structure is configured to be implanted in a bone.~~

~~17. The medical device of claim 16, wherein the structure is configured to be implanted to bridge a fracture of the bone.~~

~~18. The medical device of claim 16, wherein the structure is configured to be implanted through a hole in a plate that bridges a fracture of the bone.~~

~~19. The medical device of claim 1, wherein the structure is a screw, pin, rod, nail, a part of a joint replacement implant, a part of a spinal fixation device, or a part of other orthopedic devices.~~

~~20. The medical device of claim 1, wherein the structure comprises a shaft having an outer diameter in a range of 4 millimeters or greater.~~

~~21. The medical device of claim 1, wherein the lumen comprises a shaft portion having a diameter sized to receive at least a portion of the electronics cartridge.~~

~~22. The medical device of claim 1, wherein each of the electronics cartridge and the lumen have a respective form factor that is generally the same.~~

~~23. The medical device of claim 22, wherein the respective form factors of the electronics cartridge and the lumen comprise a head portion and a shaft portion, wherein the head portion has a diameter greater than the shaft portion.~~

~~24. The medical device of claim 1, wherein the structure and the electronics cartridge comprise mechanical features that enable the electronics cartridge to be fixedly secured within the lumen.~~

~~25. The medical device of claim 24, wherein the mechanical features comprise one of: a difference in form factor between a head of the electronics cartridge and a head portion of the lumen of the structure; a projection associated with the electronics cartridge and a recess associated with the lumen of the structure; and an interlock feature associated with a shaft of the electronics cartridge for receiving an adhesive and an inner wall of the structure for engaging the adhesive.~~

~~26. The medical device of claim 1, wherein the structure and the electronics cartridge comprise mechanical features that enable the electronics cartridge to be removed from the lumen without damaging the structural integrity of either the electronics cartridge or the structure.~~

~~27. The medical device of claim 26, wherein the mechanical features comprise complementary screw threads.~~

~~28. The medical device of claim 1, wherein the electronics cartridge comprises a head and a shaft and at least a portion of electronics are included in an electronics assembly located in the head.~~

~~29. The medical device of claim 1, wherein the electronics cartridge comprises a head and a shaft and at least a portion of electronics are included in an electronics assembly located in the shaft.~~

~~30. The medical device of claim 1, wherein:~~

~~the structure comprises an exterior surface and one or more electrodes are at the exterior surface; and~~

~~the electronics cartridge comprises an exterior surface and one or more electrical contacts at the exterior surface configured to electrically couple to the one or more electrodes when the electronics cartridge is inserted into the lumen.~~

~~31. The medical device of claim 30, wherein the structure comprises an electrically conductive substrate, and the one or more electrodes corresponds to an electrically conductive material associated with a sidewall of the electrically conductive substrate and electrically isolated from the electrically conductive substrate by an electrically insulative material.~~

32. The medical device of claim 31, further comprising a feedthrough for each of the one or more electrodes, the feedthrough extending through the sidewall of the electrically conductive substrate and providing an electrical coupling between each of the one or more electrodes and an interior of the structure.

33. The medical device of claim 30, wherein the structure comprises an electrically conductive substrate at least partially coated with an electrically insulative material, and the one or more electrodes corresponds to one or more of:

an area of the electrically conductive substrate not coated by the electrically insulative material; and

an electrically conductive material overlying the electrically insulative material.

34. The medical device of claim 30, wherein the structure comprises a substrate and the one or more electrodes corresponds to an electrically conductive material on the substrate.

35. The medical device of claim 34, wherein the substrate is of an electrically non-conductive material.

36. The medical device of claim 34, wherein:

the substrate is of an electrically conductive material; and

the one or more electrodes corresponds to an electrically conductive material overlying an electrically insulative material.

37. The medical device of claim 30, wherein the structure comprises a proximal end, a distal end, and the one or more electrodes comprise one or more of: a distal electrode near the distal end, a proximal electrode near the proximal end, a plurality of distal electrodes near the distal end, a plurality of proximal electrodes near the proximal end, and a plurality of electrodes between the proximal end and the distal end.

38. The medical device of claim 30, wherein the one or more electrodes are electrically isolated from each other and from the structure.

39. The medical device of claim 1, wherein:

the structure comprises one or more apertures through a sidewall; and

the electronics cartridge comprises one or more electrodes positioned to align with the one or more apertures when the electronics cartridge is inserted into the lumen of the structure.

40. The medical device of claim 39, wherein each of the structure and the electronics cartridge are configured to align each of the one or more electrodes with a corresponding one of the one or more apertures when the electronics cartridge is inserted into the lumen.

41. The medical device of claim 39, wherein the electronics cartridge comprises a proximal end, a distal end, and the one or more electrodes comprise one or more of: a distal electrode near the distal end, a proximal electrode near the proximal end, a plurality of distal electrodes near the distal end, a plurality of proximal electrodes near the proximal end, and a plurality of electrodes between the proximal end and the distal end.

42. The medical device of claim 39, wherein the one or more electrodes are electrically isolated from each other.

43. The medical device of claim 39, wherein:

the one or more apertures corresponds to a slot; and

the electronics cartridge comprises an electrode assembly that extends outward from a surface of the electronics cartridge, has a form factor that fits through the slot, and that includes the one or more electrodes.

44. The medical device of claim 43, wherein the electrode assembly is biased relative to the surface of the electronics cartridge to enable the electronics cartridge to transition between a compression state during which an outer surface of the electrode assembly is substantially flush with the surface of the electronics cartridge, and an expanded state during which the outer surface of the electrode assembly is elevated relative to the surface of the electronics cartridge to extend through the slot.

45. The medical device of claim 39, wherein the electrodes are associated with a shaft of the electronics cartridge and include an electrode surface that is recessed relative to a surface of the shaft such that when inserted into the lumen of the structure an empty space in communication with an aperture is formed between the electrode surface and an inner wall of the structure.

46. The medical device of claim 1, wherein:

the structure comprises a distal end opening and a proximal end opening; and

the electronics cartridge comprises a first electrode positioned to be adjacent the distal end opening and a second electrode positioned to be adjacent the proximal end opening when the electronics cartridge is inserted into the lumen of the structure.

47. The medical device of claim 1, wherein:

the structure comprises a distal end opening; and

the electronics cartridge comprises a plurality of electrodes positioned on the electronics cartridge to be located distal the distal end opening of the structure when the electronics cartridge is inserted into the lumen of the structure.

48. The medical device of claim 1, wherein the electronics comprises an antenna.

49. The medical device of claim 48, wherein:

the electronics cartridge comprises a proximal end, a distal end, a head at the proximal end, and a shaft extending from the head toward the distal end; and

the antenna is associated with the shaft.

50. The medical device of claim 49, wherein the antenna comprises a conductive wire or trace extending along a length of the shaft.

51. The medical device of claim 50, wherein the antenna extends in a helical pattern around the shaft.

52. The medical device of claim 51, wherein the antenna is electrically insulated from an outer surface of the shaft to avoid contact with the structure when the electronics cartridge is inserted into the lumen of the structure.

53. The medical device of claim 48, wherein:

the electronics cartridge comprises a proximal end, a distal end, a head at the proximal end, and a shaft extending from the head toward the distal end; and

the antenna is associated with the head.

54. The medical device of claim 53, wherein the antenna comprises a conductive wire or trace extending along a plane parallel with a base of the head.

55. The medical device of claim 1, wherein the electronics comprises one or more power sources.

56. The medical device of claim 55, wherein:

the electronics cartridge comprises a proximal end, a distal end, a head at the proximal end, and a shaft extending from the head toward the distal end; and

the one or more power sources is associated with the shaft.

57. The medical device of claim 55, wherein:

the electronics cartridge comprises a proximal end, a distal end, a head at the proximal end, and a shaft extending from the head toward the distal end; and

the one or more power sources is associated with the head.

58. The medical device of claim 55, wherein the one or more power sources comprises one or more of a battery and a capacitor.

59. The medical device of claim 55, wherein the one or more power sources comprises an energy harvesting device configured to harvest energy by one of electrostatic energy, wireless energy transfer, electro-mechanical conversion, electro-magnetic conversion, and IR radiation.

60. The medical device of claim 1, wherein the electronics comprises one or more communication components that enable communication between the medical device and another device that is either implanted in the body or external the body.

61. The medical device of claim 60, wherein the one or more communication components comprises:

an antenna; and

a radio frequency (RF) transceiver coupled to the antenna and configured to receive and transmit RF signals.

62. The medical device of claim 60, wherein the one or more communication components comprise:

a transmitter coupled to electrodes associated with the medical device and configured and located to be placed in contact with tissue; and

a receiver coupled to electrodes associated with the medical device and configured and located to be placed in contact with tissue.

~~63. The medical device of claim 60, wherein the one or more communication components are configured to at least one of:~~

~~enable capacitive coupling between the medical device and the other device; or~~

~~to enable galvanic coupling between the medical device and the other device.~~

~~64. The medical device of claim 1, wherein the electronics comprises one or more sensors.~~

~~65. The medical device of claim 64, wherein the one or more sensors comprises an accelerometer configured to output a signal corresponding to motion of the structure.~~

~~66. The medical device of claim 65, wherein the accelerometer comprises one of a one-dimensional accelerometer and a three-dimensional accelerometer.~~

~~67. The medical device of claim 65, wherein the electronics further comprise a processor coupled to the accelerometer to receive the signal and configured to process the signal to provide an indication of one or more of patient activity, integrity of the structure, and movement of the structure relative to implant location.~~

~~68. The medical device of claim 64, wherein the one or more sensors comprises a temperature sensor configured to output a signal corresponding to a temperature of the structure at an implant location.~~

~~69. The medical device of claim 64, wherein the one or more sensors comprise a strain sensor configured to output a signal corresponding to motion, force, tension, velocity, or other mechanical forces associated with the structure.~~

~~70. The medical device of claim 69, wherein the electronics further comprise a processor coupled to the strain sensor to receive signals from the strain sensor overtime and configured to process the signals to provide a characterization of a bone fracture, the characterization corresponding to a healing state of the bone fracture.~~

~~71. The medical device of claim 64, wherein the one or more sensors comprise an ultrasonic transducer configured to output a signal corresponding to ultrasound energy sensed in an area of the structure.~~

~~72. The medical device of claim 71, wherein the electronics further comprise a processor coupled to the ultrasonic transducer to receive signals from the ultrasonic transducer and configured to process the signals to provide one or more of a characterization of a bone fracture, a characterization of tissue in the area of the structure, healing area glucose.~~

~~73. The medical device of claim 64, wherein the one or more sensors comprise one or more of a glucose detector and an oxygen sensor configured to output a signal corresponding to a respective one of glucose level and oxygen level.~~

~~74. The medical device of claim 73, wherein the electronics further comprise a processor coupled to the one or more of a glucose detector and an oxygen sensor to receive the signal and configured to process the signal to provide an indication of inflammation fluid in a region of the medical device.~~

~~75. The medical device of claim 1, wherein the electronics cartridge further comprises a mechanism configured to deliver a catalyst material that produces a gaseous oxygen reaction at an implant site by a chemical reaction.~~

~~76. The medical device of claim 75, wherein the mechanism comprises one or more of:~~

~~a reservoir that releases the catalyst material at one or more times after implant under control of a time release controller; and~~

~~a coating of catalyst material on the electronics cartridge.~~

~~77~~1. A medical device comprising:

a cannulated structure having a lumen extending therethrough, and a plurality of electrodes at an outer surface of the cannulated structure, the cannulated structure configured to be at least partially implanted in a body; and

an electronics cartridge including electronics, the electronics cartridge configured to be inserted into the lumen, and to establish one or more electrical couplings between the electronics and the plurality of electrodes upon such insertion.

~~78~~2. The medical device of claim ~~77~~1, wherein the cannulated structure comprises a shaft and the plurality of electrodes comprise a single set of electrodes spaced apart along a length of the shaft.

~~79~~3. The medical device of claim ~~77~~1, wherein the cannulated structure comprises a shaft and the plurality of electrodes comprise a first set of electrodes spaced apart along a length of a first side of the shaft, and a second set of electrodes spaced apart along a length of a second side of spaced from the first side.

~~80~~4. The medical device of claim ~~77~~1, wherein the cannulated structure comprises a shaft and the plurality of electrodes comprise a first linear electrode at a first side of the shaft, and a second linear electrode at a second side of spaced from the first side.

~~81~~5. The medical device of claim ~~77~~1, wherein the cannulated structure comprises:

an electrically conductive body having an exterior surface at least partially coated with an electrically insulative material,

a first electrode of the plurality of electrodes corresponding to an exposed portion of the electrically conductive body, and

a second electrode of the plurality of electrodes that overlies a portion of the electrically insulative material.

~~82~~6. The medical device of claim ~~81~~5, wherein the electronics cartridge comprises:

a first electrical contact positioned to contact an inner surface of the electrically conductive body to thereby establish an electrical coupling between the electronics and the first electrode; and

a second electrical contact positioned to contact a portion of the second electrode to thereby establish an electrical coupling between the electronics and the second electrode.

~~83~~7. The medical device of claim ~~82~~6, wherein the electronics cartridge further comprises an insulating seal between the first electrical contact and the second electrical contact.

~~84~~8. The medical device of claim ~~82~~6, wherein the second electrode is partially coated with an electrically insulative material, and the portion of the second electrode that contacts the second electrical contact corresponds to an uncoated portion of the second electrode.

~~85~~9. The medical device of claim ~~84~~8, wherein the uncoated portion of the second electrode is located in a head portion of the lumen at a proximal end of the cannulated structure.

~~86~~10. The medical device of claim ~~77~~1, wherein the cannulated structure comprises:

a body having a head and an exterior surface at least partially coated with an electrically insulative material;

a first portion of electrically conductive material on the electrically insulative material forming a first electrode of the plurality of electrodes, a first electrical contact near the head, and a first conductive path between the first electrode and the first electrical contact; and

a second portion of electrically conductive material on the electrically insulative material forming a second electrode of the plurality of electrodes, a second electrical contact near the head, and a second conductive path between the second electrode and the second electrical contact.

~~87~~11. The medical device of claim ~~86~~10, wherein the electronics cartridge comprises:

a first electrical contact positioned to contact the first electrical contact of the cannulated structure to thereby establish an electrical coupling between the electronics and the first electrode; and

a second electrical contact positioned to contact the second electrical contact of the cannulated structure to thereby establish an electrical coupling between the electronics and the second electrode.

~~88~~12. The medical device of claim ~~77~~1, wherein the cannulated structure comprises:

a distal piece that includes a first electrode of the plurality of electrodes; and

a proximal piece that includes a second electrode of the plurality of electrodes.

~~89~~13. The medical device of claim ~~88~~12, wherein each of the distal piece and the proximal piece comprise an electrically conductive substrate with an exterior surface that is at least partially coated with an electrically insulative coating.

~~90~~14. The medical device of claim ~~88~~12, wherein the each of the distal piece and the proximal piece comprise a mechanical feature that enables a mechanical coupling between the distal piece and the proximal piece.

~~91~~15. The medical device of claim ~~77~~1, wherein the cannulated structure and the electronics cartridge comprise mechanical features that enable the electronics cartridge to be fixedly secured within the lumen.

~~92~~16. The medical device of claim ~~91~~15, wherein the mechanical features comprise one of: a difference in form factor between a head of the electronics cartridge and a head portion of the lumen of the cannulated structure; a projection associated with the electronics cartridge and a recess associated with the lumen of the cannulated structure; and an interlock feature associated

with a shaft of the electronics cartridge for receiving an adhesive and an inner wall of the cannulated structure for engaging the adhesive.

~~93~~17. The medical device of claim ~~77~~1, wherein the cannulated structure and the electronics cartridge comprise mechanical features that enable the electronics cartridge to be removed from the lumen without damaging the structural integrity of either the electronics cartridge or the cannulated structure.

~~94~~18. The medical device of claim ~~93~~17, wherein the mechanical features comprise complementary screw threads.

~~95. A medical device comprising:~~

~~a cannulated structure having a lumen extending therethrough and at least one aperture through a sidewall of the cannulated structure, the cannulated structure configured to be at least partially implanted in a body; and~~

~~an electronics cartridge including a plurality of electrodes and electronics electrically coupled to the electrodes, the electronics cartridge configured to be inserted into the lumen, and to provide alignment between the plurality of electrodes and the at least one aperture upon such insertion.~~

~~96. The medical device of claim 95, wherein:~~

~~the at least one aperture corresponds to a slot; and~~

~~the electronics cartridge comprises an electrode assembly that extends outward from a surface of the electronics cartridge, has a form factor that fits through the slot, and includes the plurality of electrodes.~~

~~97. The medical device of claim 96, wherein the electrode assembly is biased relative to the surface of the electronics cartridge to enable the electronics cartridge to transition between a compression state during which an outer surface of the electrode assembly is substantially flush with the surface of the electronics cartridge, and an expanded state during which the outer surface of the electrode assembly is elevated relative to the surface of the electronics cartridge to extend through the slot.~~

~~98. The medical device of claim 95, wherein:~~

~~the at least one aperture corresponds to a plurality of apertures; and~~

~~the electronics cartridge comprises a corresponding plurality of electrodes.~~

~~99. The medical device of claim 98, wherein the plurality of electrodes are ring electrodes recessed relative to a surface of the electronics cartridge such that when inserted into the lumen of the cannulated structure an annular space in communication with an aperture is formed between an electrode surface and an inner wall of the cannulated structure.~~

~~100. The medical device of claim 98, wherein the plurality of electrodes comprise a distal electrode and a proximal electrode.~~

~~101. The medical device of claim 98, wherein the plurality of electrodes comprise more than two electrodes arrange in an array between a distal electrode and a proximal electrode~~

~~102. A medical device comprising:~~

~~a cannulated structure having a lumen extending therethrough, and a distal end opening and a proximal end opening, the cannulated structure configured to be at least partially implanted in a body; and~~

~~an electronics cartridge including a plurality of electrodes and electronics electrically coupled to the electrodes, the electronics cartridge configured to be inserted into the lumen, and to position a first electrode of the plurality of electrodes at the distal end opening and a second electrode of the plurality of electrodes at the proximal end opening upon such insertion.~~

~~103. The medical device of claim 102, wherein the first electrode is a ring electrode recessed relative to a surface of the electronics cartridge such that when inserted into the lumen an annular space in communication with the distal end opening is formed between a surface of the first electrode and an inner wall of the cannulated structure.~~

~~104. The medical device of claim 102, wherein the cannulated structure comprises a head having an outer perimeter and the second electrode extends out from the electronics cartridge and beyond the outer perimeter.~~

~~105. A medical device comprising:~~

~~a cannulated structure having a lumen extending therethrough, and a distal end opening and a proximal end opening, the cannulated structure configured to be at least partially implanted in a body; and~~

~~an electronics cartridge including a plurality of electrodes and electronics electrically coupled to the electrodes, the electronics cartridge configured to be inserted into the lumen, and to position the plurality of electrodes distal the distal end opening upon such insertion.~~

~~106. The medical device of claim 105, wherein the electronics cartridge comprises a shaft having a length, and at least two portions of different rigidity along the length.~~

~~107. The medical device of claim 106, wherein the plurality of electrodes are associated with a less rigid portion of the at least two portions.~~

~~108. The medical device of claim 106, wherein the electronics are associated with a more rigid portion of the at least two portions.~~

~~109. A medical device configured to be at least partially implanted in a body, the medical device comprising:~~

~~a structure having a head and a shaft, each respectively defining a head cavity and a shaft cavity;~~

~~electronics located in one or more of the head cavity and the shaft cavity; and~~

~~at least one electrode associated with the shaft and electrically coupled to the electronics.~~

~~110. The medical device of claim 109, wherein the structure comprises a shaft and the at least one electrode comprises a single set of electrodes spaced apart along a length of the shaft.~~

~~111. The medical device of claim 109, wherein the structure comprises a shaft and the at least one electrode comprises a first set of electrodes spaced apart along a length of a first side of~~

~~the shaft, and a second set of electrodes spaced apart along a length of a second side of spaced from the first side.~~

~~112. The medical device of claim 109, wherein the structure comprises a shaft and the at least one electrode comprises a first linear electrode at a first side of the shaft, and a second linear electrode at a second side of spaced from the first side.~~

~~113. The medical device of claim 109, further comprising a sensor for measuring an electrical property of tissue, the sensor comprising:~~

~~a plurality of electrodes; and~~

~~a sensing module coupled to the plurality of electrodes.~~

~~114. The medical device of claim 113, wherein:~~

~~the plurality of electrodes comprise a first electrode and a second electrode; and~~

~~the sensing module is configured to enable the first electrode and the second electrode to function in either of an application mode during which a signal is applied across the electrodes, or a sensing mode during which an impedance between the electrodes is sensed.~~

~~115. The medical device of claim 114, wherein the sensing module comprises a signal generator configured to apply signals at different frequencies to measure tissue impedance in accordance with electrical impedance spectroscopy (EIS) techniques.~~

~~116. The medical device of claim 113, wherein:~~

~~the sensor further comprises an electrode switch;~~

~~the plurality of electrodes comprise a first electrode, a second electrode, a third electrode and a fourth electrode switchably coupled to the sensing module through the electrode switch; and~~

~~the sensing module is configured to enable an application mode during which a signal is applied across the first electrode and the second electrode, and to enable a sensing mode during which an impedance between the third electrode and the fourth electrode is sensed.~~

~~117. The medical device of claim 116, wherein the sensing module comprises a signal generator configured to apply signals at different frequencies to measure tissue impedance in accordance with electrical impedance spectroscopy (EIS) techniques.~~

~~118. The medical device of claim 113, wherein the electrical property of tissue comprises impedance measurements, and further comprising a controller configured to process impedance measurements overtime to determine a characterization of a bone fracture, the characterization corresponding to a healing state of the bone fracture.~~

~~119. The medical device of claim 118, wherein the healing state corresponds to one of union, likely non-union, and non-union.~~

~~120. The medical device of claim 109, wherein the structure is configured to be implanted in a bone.~~

~~121. The medical device of claim 120, wherein the structure is configured to be implanted to bridge a fracture of the bone.~~

~~122. The medical device of claim 120, wherein the structure is configured to be implanted through a hole in a plate that bridges a fracture of the bone.~~

~~123. The medical device of claim 109, wherein the structure is a screw, pin, rod, nail, a part of a joint replacement implant, a part of a spinal fixation device, or a part of other orthopedic devices.~~

~~124. The medical device of claim 109, wherein the structure comprises a shaft having an outer diameter in a range of 4 millimeters or greater.~~

~~125. The medical device of claim 109, wherein:~~

~~the structure comprises an exterior surface and one or more electrodes at the exterior surface that electrically couple to the electronics.~~

~~126. The medical device of claim 125, wherein the structure comprises a substrate, and the one or more electrodes corresponds to an electrically conductive structure extending from the exterior surface along a sidewall of the substrate to the electronics.~~

~~127. The medical device of claim 125, wherein the structure comprises a substrate, and the one or more electrodes corresponds to an electrically conductive structure extending through an aperture through a sidewall of the substrate.~~

~~128. The medical device of claim 127, wherein the electrically conductive structure comprises a layer of electrically conductive material that extends from an exterior surface of the structure, along a sidewall of the aperture, to an inner surface of the structure.~~

~~129. The medical device of claim 127, wherein the electrically conductive structure comprises a conductive pin extending through the aperture.~~

~~130. The medical device of claim 129, wherein the conductive pin is a pogo style pin that is normally biased outward from the aperture.~~

~~131. The medical device of claim 129, wherein the electrically conductive structure comprises a conductive material that fills the aperture.~~

~~132. The medical device of claim 129, wherein the substrate is of an electrically conductive material that is at least partially coated with an electrically insulative material.~~

~~133. The medical device of claim 132, wherein the aperture has a sidewall that is coated with an electrically insulative material.~~

~~134. The medical device of claim 129, wherein the substrate is of an electrically non-conductive material.~~

~~135. The medical device of claim 125, wherein the structure comprises a proximal end, a distal end, and the one or more electrodes comprise one or more of: a distal electrode near the distal end, a proximal electrode near the proximal end, a plurality of distal electrodes near the distal end, a plurality of proximal electrodes near the proximal end, and a plurality of electrodes between the proximal end and the distal end.~~

~~136. The medical device of claim 135, wherein the one or more electrodes are electrically isolated from each other.~~

~~137. The medical device of claim 109, wherein the electronics comprises an antenna.~~

~~138. The medical device of claim 137, wherein the antenna is associated with the shaft of the structure.~~

~~139. The medical device of claim 138, wherein the antenna comprises a conductive wire or trace extending along a length of the shaft.~~

~~140. The medical device of claim 139, wherein the antenna extends in a helical pattern around the shaft.~~

~~141. The medical device of claim 138, wherein the antenna is associated with the head of the structure.~~

~~142. The medical device of claim 141, wherein the antenna comprises a conductive wire or trace extending along a plane parallel with a base of the head.~~

~~143. The medical device of claim 109, wherein the electronics comprises one or more power sources.~~

~~144. The medical device of claim 143, wherein the one or more power sources is associated with the shaft of the structure.~~

~~145. The medical device of claim 143, wherein the one or more power sources is associated with the head of the structure.~~

~~146. The medical device of claim 143, wherein the one or more power sources comprises one or more of a battery and a capacitor.~~

~~147. The medical device of claim 143, wherein the one or more power sources comprises an energy harvesting device configured to harvest energy by one of electrostatic energy, wireless energy transfer, electro-mechanical conversion, electro-magnetic conversion, and IR radiation.~~

~~148. The medical device of claim 109, wherein the electronics comprises one or more communication components that enable communication between the medical device and another device either implanted in the body or external the body.~~

~~149. The medical device of claim 148, wherein the one or more communication components comprises:~~

~~an antenna; and~~

~~a radio frequency (RF) transceiver coupled to the antenna and configured to receive and transmit RF signals.~~

~~150. The medical device of claim 148, wherein the one or more communication components comprise:~~

~~a transmitter coupled to electrodes associated with the medical device and configured and located to be placed in contact with tissue; and~~

~~a receiver coupled to electrodes associated with the medical device and configured and located to be placed in contact with tissue.~~

~~151. The medical device of claim 150, wherein the one or more communication components are configured to at least one of:~~

~~enable capacitive coupling between the medical device and the other device; or~~

~~to enable galvanic coupling between the medical device and the other device.~~

~~152. The medical device of claim 109, wherein the electronics comprises one or more sensors.~~

~~153. The medical device of claim 152, wherein the one or more sensors comprises an accelerometer configured to output a signal corresponding to motion of the structure.~~

~~154. The medical device of claim 153, wherein the accelerometer comprises one of a one-dimensional accelerometer and a three-dimensional accelerometer.~~

~~155. The medical device of claim 153, wherein the electronics further comprise a processor coupled to the accelerometer to receive the signal and configured to process the signal to provide an indication of one or more of patient activity, integrity of the structure, and movement of the structure relative to implant location.~~

~~156. The medical device of claim 152, wherein the one or more sensors comprises a temperature sensor configured to output a signal corresponding to a temperature of the structure at an implant location.~~

~~157. The medical device of claim 152, wherein the one or more sensors comprise a strain sensor configured to output a signal corresponding to motion, force, tension, velocity, or other mechanical forces associated with the structure.~~

~~158. The medical device of claim 157, wherein the electronics further comprise a processor coupled to the strain sensor to receive signals from the strain sensor overtime and configured to process the signals to provide a characterization of a bone fracture, the characterization corresponding to a healing state of the bone fracture.~~

~~159. The medical device of claim 152, wherein the one or more sensors comprise an ultrasonic transducer configured to output a signal corresponding to ultrasound energy sensed in an area of the structure.~~

~~160. The medical device of claim 159, wherein the electronics further comprise a processor coupled to the ultrasonic transducer to receive signals from the ultrasonic transducer and configured to process the signals to provide one or more of a characterization of a bone fracture, a characterization of tissue in the area of the structure, and glucose level.~~

~~161. The medical device of claim 152, wherein the one or more sensors comprise one or more of a glucose detector and an oxygen sensor configured to output a signal corresponding to a respective one of glucose level and oxygen level.~~

~~162. The medical device of claim 161, wherein the electronics further comprise a processor coupled to the one or more of a glucose detector and an oxygen sensor to receive the signal and configured to process the signal to provide an indication of inflammation fluid in a region of the medical device.~~

~~163. The medical device of claim 109, further comprising a mechanism configured to deliver a catalyst material that produces a gaseous oxygen reaction at an implant site by a chemical reaction.~~

~~164. The medical device of claim 163, wherein the mechanism comprises one or more of:~~

~~a reservoir that releases the catalyst material at one or more times after implant under control of a time release controller; and~~

~~a coating of catalyst material on the structure.~~

~~165. A medical device comprising:~~

~~a cannulated structure having a lumen extending therethrough, a plurality of apertures through a sidewall, and a plurality of electrodes each associated with one of the plurality of apertures, the cannulated structure configured to be at least partially implanted in a body; and~~

~~an electronics cartridge including electronics, the electronics cartridge at least partially within the lumen, and comprising a plurality of electrical contacts each aligned with one of the apertures to establish an electrical coupling between the electronics and each of the plurality of electrodes.~~

~~166. The medical device of claim 165, wherein:~~

~~the cannulated structure comprises a shaft,~~

~~the plurality of apertures comprises a single set of apertures spaced apart along a length of the shaft, and~~

~~the plurality of electrodes comprises a single set of electrodes spaced apart along a length of the shaft.~~

~~167. The medical device of claim 165, wherein:~~

~~the cannulated structure comprises a shaft,~~

~~the plurality of apertures comprises a first set of apertures spaced apart along a length of a first side of the shaft, and a second set of apertures spaced apart along a length of a second side of spaced from the first side, and~~

~~the plurality of electrodes comprises a first set of electrodes spaced apart along a length of a first side of the shaft, and a second set of electrodes spaced apart along a length of a second side of spaced from the first side.~~

~~168. The medical device of claim 165, wherein:~~

~~the cannulated structure comprises a shaft,~~

~~the plurality of apertures comprises a first linear slot at a first side of the shaft, and a second linear slot at a second side of spaced from the first side, and~~

~~the plurality of electrodes comprises a first linear electrode at a first side of the shaft, and a second linear electrode at a second side of spaced from the first side.~~

~~169. The medical device of claim 165, wherein:~~

~~the cannulated structure comprises a substrate having an outer surface and an inner surface, and~~

the plurality of electrodes comprises:

a first electrode on the outer surface and having a feedthrough that extends through a first aperture of the plurality of apertures to the inner surface of the substrate, and

a second electrode on the outer surface and having a feedthrough that extends through a second aperture of the plurality of apertures to the inner surface of the substrate.

170. The medical device of claim 169, wherein the substrate comprises an electrically insulative material.

171. The medical device of claim 169, wherein the substrate comprises an electrically conductive material coated with an electrically insulative material.

172. The medical device of claim 169, wherein the electronics cartridge comprises:

a first electrical contact of the plurality of electrical contacts positioned to contact the feedthrough of the first electrode on the inner surface of the substrate to thereby establish an electrical coupling between the electronics and the first electrode; and

a second electrical contact of the plurality of electrical contacts positioned to contact the feedthrough of the second electrode on the inner surface of the substrate to thereby establish an electrical coupling between the electronics and the second electrode.

173. The medical device of claim 165, wherein the plurality of electrodes comprise:

a first conductive structure that extends through a first aperture of the plurality of apertures; and

a second conductive structure that extends through a second aperture of the plurality of apertures to an inner surface of the body.

174. The medical device of claim 173, wherein the first conductive structure corresponds to a first conductive pin and the second conductive structure corresponds to a second conductive pin.

175. The medical device of claim 174, wherein each of the first conductive pin and the second conductive pin is a pogo style pin that is normally biased outward from the first aperture or the second aperture.

176. The medical device of claim 173, wherein each of the first conductive structure and the second conductive structure corresponds to a conductive material that fills the first aperture or the second aperture.

177. An implantable medical device for characterizing a bone fracture in a bone, the medical device comprising:

an implant configured to be at least partially implanted in the bone and across the bone fracture;

an impedance sensor included in the implant and comprising:

a first electrode and a second electrode; and

a sensing module configured to obtain impedance measurements between the first electrode and the second electrode;

~~a controller and memory included in the implant and configured to process and store the impedance measurements; and~~

~~communication circuitry included in the implant and configured to transmit the impedance measurements to an external device.~~

~~178. The medical device of claim 177, wherein the sensing module is configured to enable the first electrode and the second electrode to function in either of an application mode during which a signal is applied across the first electrode and the second electrode, or a sensing mode during which an impedance between the first electrode and the second electrode is sensed.~~

~~179. The medical device of claim 178, wherein the sensing module comprises a signal generator configured to apply signals at different frequencies to measure tissue impedance in accordance with electrical impedance spectroscopy (EIS) techniques.~~

~~180. The medical device of claim 177, wherein:~~

~~the impedance sensor further comprises a third electrode and a fourth electrode; and~~

~~the sensing module is configured to enable an application mode during which a signal is applied across the first and second electrodes, and to enable a sensing mode during which an impedance between the third and fourth electrodes is sensed.~~

~~181. The medical device of claim 180, wherein the sensing module comprises a signal generator configured to apply signals at different frequencies to measure tissue impedance in accordance with electrical impedance spectroscopy (EIS) techniques.~~

~~182. The medical device of claim 177, wherein the controller is further configured to process impedance measurements overtime to determine a characterization of the bone fracture, the characterization corresponding to a healing state of the bone fracture.~~

~~183. The medical device of claim 182, wherein the healing state corresponds to one of union, likely non-union, and non-union.~~

~~184. The medical device of claim 177, wherein the first electrode and the second electrode are spaced apart on the implant to enable placement of the first electrode and the second electrode on opposite sides of the bone fracture.~~

~~185. The medical device of claim 177, wherein the impedance sensor comprises a plurality of electrodes including the first electrode, the second electrode and at least one additional electrode, wherein the sensing module is configured to select the first electrode and the second electrode from the plurality of electrodes based on impedance measurements such that the first electrode and the second electrode are on opposite sides of the bone fracture.~~

~~186. The medical device of claim 177, wherein the communication circuitry comprises tissue conductive communication circuitry coupled to the first electrode and the second electrode and configured to enable capacitive coupling between the medical device and another other device, or to enable galvanic coupling between the medical device and another device.~~

~~187. The medical device of claim 177, wherein the implant comprises:~~

~~a structure having a lumen extending at least partially therethrough, and configured to be at least partially implanted in the bone and across the bone fracture; and~~

~~an electronics cartridge including at least a portion of the impedance sensor, the controller, the memory, and at least a portion of the communication circuitry, the electronics cartridge configured to be inserted into the lumen after implant of the structure.~~

~~188. The medical device of claim 187, wherein the structure comprises an exterior surface and the first electrode and the second electrode are at the exterior surface.~~

~~189. The medical device of claim 187, wherein:~~

~~the structure comprises at least one aperture through a sidewall; and~~

~~the electronics cartridge comprises an exterior surface and the first electrode and the second electrode are at the exterior surface and positioned to align with the at least one aperture when the electronics cartridge is inserted into the lumen of the structure.~~

~~190. The medical device of claim 187, wherein the structure is a screw, pin, rod, nail, a part of a joint replacement implant, a part of a spinal fixation device, or a part of other orthopedic devices.~~

~~191. The medical device of claim 177, wherein the implant comprises a single structure.~~

~~192. The medical device of claim 191, wherein the single structure is a screw, pin, rod, nail, a part of a joint replacement implant, a part of a spinal fixation device, or a part of other orthopedic devices.~~

~~193. A method of characterizing a bone fracture, the method comprising:~~

~~obtaining a plurality of measures of an electrical property of tissue overtime through a plurality of electrodes located in a boney tissue and across a bone fracture, the plurality of electrodes including a first electrode and a second electrode on opposite sides of the bone fracture; and~~

~~processing the measures to determine a characterization of a bone fracture, the characterization corresponding to a healing state of the bone fracture.~~

~~194. The method of claim 193, wherein the healing state corresponds to one of union, likely non-union, and non-union.~~

~~195. The method of claim 193, further comprising communicating the plurality of measures of an electrical property of tissue, or the characterization of a bone fracture to an external device.~~

~~196. The method of claim 193, wherein the electrical property of tissue comprises impedance, and obtaining a plurality of measures comprises:~~

~~applying signals at different frequencies to the first electrode to measure tissue impedance in accordance with electrical impedance spectroscopy (EIS) techniques.~~

~~197. The method of 196, wherein the signals are applied by an implanted sensing module.~~

198. The method of claim 193, further comprising implanting the plurality of electrodes to place the first electrode and the second electrode on opposite sides of the bone fracture.

199. The method of claim 198, wherein implanting the plurality of electrodes comprises:

implanting at least one cannulated structure into the boney tissue and across the bone fracture, the cannulated structure having a lumen extending at least partially therethrough; and

after implanting the cannulated structure, inserting an electronics cartridge into the lumen, the electronics cartridge including a sensing module.

200. The method of claim 199, wherein the plurality of electrodes are carried by the cannulated structure, and couple to the sensing module upon insertion of the electronics cartridge into the lumen.

201. The method of claim 199, wherein the plurality of electrodes are carried by the electronics cartridge, and interface with boney tissue through a plurality of apertures in a sidewall of the cannulated structure.

202. The method of claim 199, further comprising securing the electronics cartridge to the cannulated structure.

203. The method of claim 198, wherein implanting the plurality of electrodes comprises:

implanting a medical device including a structure carrying the plurality of electrodes, and electronics located in the structure and coupled to the plurality of electrodes.

204. A method of characterizing a bone fracture, the method comprising:

obtaining a plurality of measures of an electrical property of tissue overtime through a plurality of electrodes located in a boney tissue at a bone fracture, the plurality of electrodes including a first electrode and a second electrode, each within a gap of the bone fracture; and

processing the measures to determine a characterization of a bone fracture, the characterization corresponding to a healing state of the bone fracture.

205. The method of claim 204, wherein the healing state corresponds to one of union, likely non-union, and non-union.

206. The method of claim 204, further comprising communicating the plurality of measures of an electrical property of tissue, or the characterization of a bone fracture to an external device.

207. The method of claim 204, wherein the electrical property of tissue comprises impedance, and obtaining a plurality of measures comprises:

applying signals at different frequencies to the first electrode to measure tissue impedance in accordance with electrical impedance spectroscopy (EIS) techniques.

208. The method of 207, wherein the signals are applied by an implanted sensing module.

209. The method of claim 204, further comprising implanting the plurality of electrodes to place the first electrode and the second electrode within the gap of the bone fracture.

210. The method of claim 209, wherein implanting the plurality of electrodes comprises:

implanting at least one cannulated structure into the boney tissue and across the gap of the bone fracture, the cannulated structure having a lumen extending at least partially therethrough; and

after implanting the cannulated structure, inserting an electronics cartridge into the lumen, the electronics cartridge including a sensing module.

211. The method of claim 210, wherein the plurality of electrodes are carried by the cannulated structure, and couple to the sensing module upon insertion of the electronics cartridge into the lumen.

212. The method of claim 210, wherein the plurality of electrodes are carried by the electronics cartridge, and interface with boney tissue through a plurality of apertures in a sidewall of the cannulated structure.

213. The method of claim 210, further comprising securing the electronics cartridge to the cannulated structure.

214. The method of claim 209, wherein implanting the plurality of electrodes comprises:

implanting a medical device including a structure carrying the plurality of electrodes, and electronics located in the structure and coupled to the plurality of electrodes.

215. A method of characterizing a bone fracture, the method comprising:

obtaining a plurality of measures of an electrical property of tissue overtime through a plurality of electrodes located in a boney tissue at a bone fracture, the plurality of electrodes including a first electrode and a second electrode, each spanning a gap of the bone fracture; and

processing the measures to determine a characterization of a bone fracture, the characterization corresponding to a healing state of the bone fracture.

216. The method of claim 215, wherein the healing state corresponds to one of union, likely non-union, and non-union.

217. The method of claim 215, further comprising communicating the plurality of measures of an electrical property of tissue, or the characterization of a bone fracture to an external device.

218. The method of claim 215, wherein the electrical property of tissue comprises impedance, and obtaining a plurality of measures comprises:

applying signals at different frequencies to the first electrode to measure tissue impedance in accordance with electrical impedance spectroscopy (EIS) techniques.

219. The method of 218, wherein the signals are applied by an implanted sensing module.

220. The method of claim 215, further comprising implanting the plurality of electrodes to place the first electrode and the second electrode to span the gap of the bone fracture.

221. The method of claim 220, wherein implanting the plurality of electrodes comprises:

implanting at least one cannulated structure into the boney tissue and across the gap of the bone fracture, the cannulated structure having a lumen extending at least partially therethrough; and

after implanting the cannulated structure, inserting an electronics cartridge into the lumen, the electronics cartridge including a sensing module.

222. The method of claim 221, wherein the plurality of electrodes are carried by the cannulated structure, and couple to the sensing module upon insertion of the electronics cartridge into the lumen.

223. The method of claim 221, wherein the plurality of electrodes are carried by the electronics cartridge, and interface with boney tissue through a plurality of apertures in a sidewall of the cannulated structure.

224. The method of claim 221, further comprising securing the electronics cartridge to the cannulated structure.

225. The method of claim 220, wherein implanting the plurality of electrodes comprises:

implanting a medical device including a structure carrying the plurality of electrodes, and electronics located in the structure and coupled to the plurality of electrodes.

226. An implantable medical device for characterizing a bone fracture in a bone, the medical device comprising:

a first implant configured to be at least partially implanted in the bone, the first implant having a first electrode;

a second implant configured to be at least partially implanted in the bone, the second implant having a second electrode;

a third implant configured to be placed on the bone across the bone fracture and secured in place by the first implant and the second implant;

an impedance sensor comprised of:

the first electrode and the second electrode; and

a sensing module included in one of the first, second or third implants and configured to obtain impedance measurements between the first electrode and the second electrode;

a controller and memory included in one of the first, second or third implants and configured to process and store the impedance measurements; and

communication circuitry included in one of the first, second or third implants and configured to transmit the impedance measurements to an external device.

227. The medical device of claim 226, wherein the third implant is configured to allow for coupling of the first implant and the second implant at respective locations along the third implant that place the first electrode and the second electrode on opposite sides of the bone fracture.

228. The medical device of claim 226, wherein the sensing module is configured to enable the first electrode and the second electrode to function in either of an application mode

during which a signal is applied across the first electrode and the second electrode, or a sensing mode during which an impedance between the first electrode and the second electrode is sensed.

229. The medical device of claim 228, wherein the sensing module comprises a signal generator configured to apply signals at different frequencies to measure tissue impedance in accordance with electrical impedance spectroscopy (EIS) techniques.

230. The medical device of claim 226, wherein the controller is further configured to process impedance measurements overtime to determine a characterization of the bone fracture, the characterization corresponding to a healing state of the bone fracture.

231. The medical device of claim 230, wherein the healing state corresponds to one of union, likely non-union, and non-union.

232. The medical device of claim 226, wherein the communication circuitry comprises tissue conductive communication circuitry coupled to the first electrode and the second electrode and configured to enable capacitive coupling between the medical device and another other device, or to enable galvanic coupling between the medical device and another device.

233. The medical device of claim 226, wherein at least one of the first implant and the second implant comprises:

a structure having a lumen extending at least partially therethrough, and configured to be at least partially implanted in the bone and across the bone fracture; and

an electronics cartridge including at least a portion of the impedance sensor, the controller, the memory, and at least a portion of the communication circuitry, the electronics cartridge configured to be inserted into the lumen after implant of the structure.

234. The medical device of claim 233, wherein the structure comprises an exterior surface and the first electrode or the second electrode are at the exterior surface.

235. The medical device of claim 233, wherein:

the structure comprises at least one aperture through a sidewall; and

the electronics cartridge comprises an exterior surface and the first electrode or the second electrode are at the exterior surface and positioned to align with the at least one aperture when the electronics cartridge is inserted into the lumen of the structure.

236. The medical device of claim 233, wherein the structure is a screw, pin, rod, nail, a part of a joint replacement implant, a part of a spinal fixation device, or a part of other orthopedic devices.

237. The medical device of claim 228, wherein at least one of the first implant and the second implant comprises a single structure.

238. The medical device of claim 237, wherein the single structure is a screw, pin, rod, nail, a part of a joint replacement implant, a part of a spinal fixation device, or a part of other orthopedic devices.

239. A method of manufacturing an implantable medical device, the method comprising:

creating a plurality of apertures through a sidewall of a cannulated structure configured to be at least partially implanted in a body and having a lumen extending therethrough;

associating an electrode with each of the plurality of apertures; and

associating an electronics cartridge with the lumen of the cannulated structure, the electronics cartridge including electronics and a plurality of electrical contacts, wherein the associating aligns each of the plurality of electrical contacts with one of the apertures to establish an electrical coupling between the electronics and each electrode.

240. The method of claim 239, wherein the cannulated structure comprises an electrically conductive material, and associating an electrode with each of the plurality of apertures comprises:

applying an electrically insulating material to the cannulated structure in an area of each of the plurality of apertures; and

applying an electrically conductive material over the electrically insulating material in an area of each of the plurality of apertures.

241. The method of claim 239, wherein the cannulated structure comprises an electrically insulative material, and associating an electrode with each of the plurality of apertures comprises:

applying an electrically conductive material over surfaces of the cannulated structure in an area of each of the plurality of apertures.

242. The method of claim 239, wherein the cannulated structure comprises an electrically conductive material, and associating an electrode with each of the plurality of apertures comprises:

applying an electrically insulating material to the cannulated structure in an area of each of the plurality of apertures; and

placing an electrically conductive structure through each of the plurality of apertures.

243. The method of claim 242, wherein placing an electrically conductive structure comprises inserting a conductive pin through each of the plurality of apertures.

244. The method of claim 242, wherein placing an electrically conductive structure comprises filling each of the plurality of apertures with an electrically conductive material.

245. The method of claim 239, wherein the cannulated structure comprises an electrically insulative material, and associating an electrode with each of the plurality of apertures comprises at least one of:

inserting a conductive pin through each of the plurality of apertures; and

filling each of the plurality of apertures with an electrically conductive material.

246. A method of implanting a medical device, the method comprising:

implanting an implant structure at least partially in a body, the implant structure having a lumen extending at least partially therethrough; and

after implanting the implant structure, inserting an electronics cartridge into the lumen.

~~247. The method of claim 246, wherein the implant structure comprises a proximal end having a head, and a shaft extending from the head to a distal end of the implant structure, and implanting the implant structure comprises:~~

~~inserting a support structure into the shaft and at least partially along a length of the lumen; and~~

~~rotating the support structure together with the implant structure.~~

~~248. The method of claim 247, wherein rotating the support structure together with the implant structure comprises transmitting rotational torque from the support structure to a portion of the shaft.~~

~~249. The method of claim 248, wherein the shaft and the support structure are configured to mechanically couple to enable a direct transmission of rotational torque to the shaft.~~

~~250. The method of claim 247, further comprising, prior to inserting a support structure, placing the implant structure over a guidewire placed across a bone fracture.~~

~~251. The method of claim 246, wherein the implant structure comprises a proximal end having a head, and a shaft extending from the head to a distal end of the implant structure, and implanting the implant structure comprises:~~

~~placing the implant structure in a coupling device comprising a body configured to establish a mechanical coupling with a distal end portion of the implant structure; and~~

~~rotating the coupling device together with the implant structure.~~

~~252. The method of claim 251, wherein rotating the coupling device together with the implant structure comprises transmitting rotational torque along a length of the body to the mechanical coupling and to distal end portion of the implant structure.~~

~~253. The method of claim 252, wherein the coupling device couples to the implant structure only at the distal end portion of the implant structure.~~

~~254. The method of claim 246, further comprising securing the electronics cartridge to the implant structure.~~

~~255. The method of claim 254, further comprising:~~

~~after securing the electronics cartridge to the implant structure, removing the electronics cartridge from the lumen without affecting the structural integrity of the implant structure or the electronics cartridge.~~

~~256. The method of claim 255, further comprising:~~

~~after removing the electronics cartridge from the lumen, inserting a replacement electronics cartridge in the lumen of the implant structure.~~

~~257. A tool for implanting an implant structure having a proximal end having a head, a shaft extending from the head to a distal end of the implant structure, and a lumen extending through the shaft, the tool comprising:~~

~~a drill bit; and~~

~~a mechanism for applying rotational torque to the drill bit,~~

~~wherein the drill bit comprises:~~

~~a first portion configured to directly couple to the head of the implant structure; and~~

~~a second portion extending from the first portion, the second portion configured to extend at least partially into the lumen of the implant structure.~~

~~258. The tool of claim 257, wherein the second portion comprises a mechanical feature configured to mechanically couple with a corresponding feature of the shaft to thereby enable transmission of rotational torque from the second portion to the shaft.~~

~~259. A coupling device for implanting an implant structure having a proximal end having a head, and a shaft extending from the head to a distal end of the implant structure, the coupling device comprising:~~

~~a body having a proximal end region and a distal end region configured to establish a mechanical coupling to a distal end portion of the implant structure; and~~

~~a cap configured to the couple to the proximal end region of the body without directly coupling to the implant structure.~~

~~260. The coupling device of claim 259, wherein:~~

~~the cap is configured to couple to a tool, receive rotational torque from the tool through the coupling, and transmit rotational torque along a length of the body to the mechanical coupling and to the distal end portion of the implant structure.~~

~~261. The coupling device of claim 259, wherein the coupling device is configured to couple to the implant structure only at the distal end portion of the implant structure.~~

~~262. The medical device of any of claims 1-192 and 226-238, wherein the medical device is sterile.~~

~~263. The medical device of any of claims 1-192 and 226-238, wherein the medical device has been subjected to a sterilization procedure to provide a sterile medical device.~~

~~264. A method of treating a fracture in boney tissue, the method comprising identifying a fracture in boney tissue, and inserting a medical device according to any of claims 1-192, 226-238 and 262-263 into the bony tissue, where the medical device is inserted across the fracture.~~

~~265. The method of claim 264 wherein the medical device is a medical device according to any of claims 1-76.~~

~~266. The method of claim 264 wherein the medical device is a medical device according to any of claims 77-94.~~

~~267. The method of claim 264 wherein the medical device is a medical device according to any of claims 95-101.~~

~~268. The method of claim 264 wherein the medical device is a medical device according to any of claims 102-104.~~

~~269. The method of claim 264 wherein the medical device is a medical device according to any of claims 105-108.~~

~~270. The method of claim 264 wherein the medical device is a medical device according to any of claims 109-164.~~

~~271. The method of claim 264 wherein the medical device is a medical device according to any of claims 165-176.~~

~~272. The method of claim 264 wherein the medical device is a medical device according to any of claims 177-192.~~

~~273. The method of claim 264 wherein the medical device is a medical device according to any of claims 226-238.~~

~~274. The method of claim 264 wherein the medical device is a medical device according to any of claims 262-263.~~

~~275. The method of any claims 264-274 wherein the medical device is a screw.~~

~~276. The method of any of claims 264-275 further comprising characterizing the fraction with the medical device.~~

~~277. A method of characterizing a fracture in boney tissue, the method comprising identifying a fracture in boney tissue, inserting a medical device according to any of claims 1-192, 226-238 and 262-263 into the bony tissue, where the medical device is inserted across the fracture; and characterizing the fracture with a sensor located in the medical device.~~

~~278. The method of claim 277 wherein the medical device is a medical device according to any of claims 1-76.~~

~~279. The method of claim 277 wherein the medical device is a medical device according to any of claims 77-94.~~

~~280. The method of claim 277 wherein the medical device is a medical device according to any of claims 95-101.~~

~~281. The method of claim 277 wherein the medical device is a medical device according to any of claims 102-104.~~

~~282. The method of claim 277 wherein the medical device is a medical device according to any of claims 105-108.~~

~~283. The method of claim 277 wherein the medical device is a medical device according to any of claims 109-164.~~

~~284. The method of claim 277 wherein the medical device is a medical device according to any of claims 165-176.~~

~~285. The method of claim 277 wherein the medical device is a medical device according to any of claims 177-192.~~

~~286. The method of claim 277 wherein the medical device is a medical device according to any of claims 226-238.~~

~~287. The method of claim 277 wherein the medical device is a medical device according to any of claims 262-263.~~

~~288. The method according to any of claims 277-287 wherein the medical device is a screw.~~

~~289. A set of medical devices, the set comprising at least one first medical device according to any of claims 1-192, 226-238 and 262-263, the set further comprising at least one second medical device configured for insertion into boney tissue, where the second medical device does not contain a sensor.~~

~~290. The set of medical devices of claim 289 wherein each of the first medical device and the second medical device is a screw.~~

~~291. The set of medical devices of claim 289 comprising a single first medical device and a plurality of second medical devices.~~

~~292. The set of medical devices of claim 291 wherein each member of the set is a screw.~~

19. The medical device of any of claims 1-18, wherein the medical device is sterile.

20. The medical device of any of claims 1-18, wherein the medical device has been subjected to a sterilization procedure to provide a sterile medical device.

21. A method of characterizing a fracture in boney tissue, the method comprising identifying a fracture in boney tissue, inserting a medical device according to any of claims 1-18 into the bony tissue, where the medical device is inserted across the fracture; and characterizing the fracture with a sensor located in the medical device.

22. The method according to claim 21 wherein the medical device is a screw.

23. A set of medical devices, the set comprising at least one first medical device according to any of claims 1-18, the set further comprising at least one second medical device configured for insertion into boney tissue, where the second medical device does not contain a sensor.

24. The set of medical devices of claim 23 wherein each of the first medical device and the second medical device is a screw.

25. The set of medical devices of claim 23 comprising a single first medical device and a plurality of second medical devices.

26. The set of medical devices of claim 25 wherein each member of the set is a screw.