CLAIMS

What is claimed is:

1. A bone marrow aspiration device comprising:

an introducer needle including

an introducer cannula having a proximal end and a distal end, each end including an opening,

an introducer handle connected to the proximal end of the introducer cannula, and

a removable introducer stylet having a proximal end and a distal end, the stylet extending through the introducer cannula from the cannula handle, the distal end of the stylet extending beyond the distal end of the introducer cannula and including a sharp tip to penetrate bone;

an aspiration needle receivable in the introducer cannula when the introducer stylet is removed from the introducer needle, the aspiration needle including

an aspiration cannula having a proximal end and a distal end, the proximal end including an opening,

an aspiration handle connected to the proximal end of the aspiration cannula, and

a removable blunt stylet having a proximal end and a distal end, the stylet extending through at least a portion of the aspiration cannula from the aspiration handle,

the aspiration cannula forming a channel for aspirating bone marrow when the blunt stylet is removed; and

a locking mechanism to lock the aspiration cannula to the introducer cannula when the aspiration cannula is received in the introducer cannula, the aspiration cannula being able to advance distally relative to the introducer cannula in a controlled manner, the locking mechanism causing the introducer cannula to move proximally with the aspiration cannula when the aspiration cannula is pulled proximally.

2. The aspiration device of claim 1, wherein the locking mechanism includes a ratchet mechanism.

3. The aspiration device of claim 2, wherein the ratchet mechanism includes one or more teeth at the introducer needle configured to engage the aspiration cannula.

4. The aspiration device of claim 2, wherein the ratchet mechanism includes a tube positioned over a proximal portion of the aspiration cannula, the tube including at least one of ratchet teeth to engage the introducer handle and holes to engage with a pin of introducer handle.

5. The aspiration device of claim 2, wherein the ratchet mechanism includes a release button to unlock the aspiration cannula from the introducer cannula.

6. The aspiration device of claim 2, wherein the ratchet mechanism includes an extension extending distally from the aspiration handle and configured to mate with the introducer handle, the extension and the introducer handle having respective mating ratchet teeth.

7. The aspiration device of claim 1, wherein the locking mechanism includes a screw mechanism.

8. The aspiration device of claim 7, wherein the screw mechanism includes a threaded guide in a threaded tube, the guide being attached to the aspiration cannula and the tube configured to couple to the introducer cannula.

9. The aspiration device of claim 8, wherein the tube is configured to couple to the introducer via a luer connection, the luer connection and screw mechanism providing an air-tight fit.

10. The aspiration device of claim 8, wherein the guide is hollow and the aspiration cannula passes through the hollow guide and the tube.

11. The aspiration device of claim 8, wherein the screw mechanism is configured to advance the aspiration cannula distally when the aspiration handle is turned in one direction and to withdrawn the aspiration cannula proximally when the aspiration handle is turned in an opposite direction.

12. The aspiration device of claim 11, wherein a length of the aspiration cannula that extends beyond the distal end of the introducer cannula is adjustable by advancing the threaded guide into the threaded tube or reversing the threaded guide out of the threaded tube.

13. The aspiration device of claim 7, further including a depth guide coupled to the introducer handle, the depth guide configured to control depth of entry of the introducer cannula into bone.

14. The aspiration device of claim 13, wherein the depth guide is adjustable and includes a lead screw and a threaded tube, whereby a length of the introducer cannula that extends beyond a distal end of the depth guide is adjustable by advancing the lead screw into the threaded tube or reversing the lead screw out of the threaded tube.

15. The aspiration device of claim 14, wherein the lead screw is attached to the introducer handle.

16. The aspiration device of claim 14, wherein the lead screw is hollow and the introducer cannula extends through the hollow lead screw.

17. The aspiration device of claim 14, wherein the length of the introducer cannula that extends beyond the distal end of the depth guide is adjustable between about 1 and about 8 inches.

18. The aspiration device of claim 1, wherein the distal end of the aspiration cannula is open and the distal end of the blunt stylet is configured to extend beyond the distal end of the aspiration cannula.

19. The aspiration device of claim 1, wherein the distal end of the aspiration cannula is closed and the aspiration cannula includes a port in fluid communication with the channel for aspirating bone marrow

20. The aspiration device of claim 19, wherein the port is near the distal end of aspiration cannula.

21. The aspiration device of claim 19, wherein the port includes plural ports along a length of the aspiration cannula.

22. The aspiration device of claim 21, wherein the ports vary in size along a length of the aspiration cannula.

23. The aspiration device of claim 22, wherein ports near the proximal end of aspiration cannula are larger than ports near the distal end of aspiration cannula.

24. The aspiration device of claim 1, wherein the aspiration cannula is flexible and includes a wire wound tube.

25. The aspiration device of claim 24, wherein the wire wound tube has a winding in one direction, and wherein the locking mechanism is configured to allow the aspiration cannula to be withdrawn from the bone marrow by turning the aspiration handle in a direction opposite to direction of the winding, whereby the wire wound tube is tightened as the aspiration cannula is withdrawn.

26. The aspiration device of claim 1, wherein the length of the aspiration cannula is substantially greater than the length of the introducer cannula.

27. The aspiration device of claim 1, wherein the stiffness of the assembled introducer cannula and stylet is sufficiently high to allow the introducer cannula and stylet to penetrate cortical bone when a longitudinal force is applied to the introducer cannula and stylet in a distal direction.

28. The aspiration device of claim 27, wherein the aspiration cannula is flexible, and wherein the stiffness of the assembled aspiration cannula and blunt stylet is sufficiently high to allow the aspiration cannula and blunt stylet to penetrate bone marrow when a longitudinal force is applied to the aspiration cannula and blunt stylet in a distal direction.

29. The aspiration device of claim 28, wherein the stiffness of the assembled aspiration cannula and blunt stylet is sufficiently low to not allow the aspiration cannula and blunt stylet to penetrate cortical bone but to flex or bend when a longitudinal force is applied to the aspiration cannula and blunt stylet in a distal direction.

30. The aspiration device of claim 1, wherein the distal end of the blunt stylet includes an atraumatic tip.

31. The aspiration device of claim 1, wherein the aspiration handle includes a port in fluid communication with the aspiration cannula for aspirating or injecting fluid or fluid containing cells, including bone marrow.

32. The aspiration device of claim 1, wherein the aspiration cannula and blunt stylet, upon insertion through the introducer cannula into a bone cavity, will advance through spongy bone marrow inside the bone cavity but will deflect off cortical bone, thereby conforming to the shape of the bone cavity.

33. The aspiration device of claim 1, wherein the persistence in length of the aspiration cannula is such that the maximum angle of deflection for the first 0.5 inch segment of the aspiration cannula that extends beyond the distal end of the introducer cannula is between 0 and 30 degrees.

34. A bone marrow aspiration device comprising:
an introducer needle including
an introducer cannula having a proximal end and a distal end, each end including an opening,
an introducer handle connected to the proximal end of the introducer cannula, and
a removable introducer stylet having a proximal end and a distal end, the stylet extending through the introducer cannula from the cannula handle, the distal end of the stylet extending beyond the distal end of the introducer cannula and including a sharp tip to penetrate bone;
an aspiration needle receivable in the introducer cannula when the introducer stylet is removed from the introducer needle, the aspiration needle including
an aspiration cannula having a proximal end and a distal end, the proximal end including an opening and the distal end being closed, the aspiration cannula forming a channel for aspirating bone marrow, and
an aspiration handle connected to the proximal end of the aspiration cannula; and
an adjustable depth guide coupled to the introducer handle, the depth guide configured to control depth of entry of the introducer cannula into bone.

35. The aspiration device of claim 34, wherein the introducer cannula includes plural holes.

36. The aspiration device of claim 35, wherein the holes are near the distal end of the introducer cannula.

37. The aspiration device of claim 35, wherein the aspiration cannula includes a cutout alignable with at least one of the plural holes of the introducer cannula.

38. The aspiration device of claim 37, wherein the distal end of the aspiration cannula is configured to close the opening of the distal end of the introducer cannula.

39. The aspiration device of claim 34, wherein the aspiration needle includes a connector to couple to the introducer needle in an air-tight manner.

40. The aspiration device of claim 34, wherein the depth guide includes a lead screw and a threaded tube, whereby a length of the introducer cannula that extends beyond a distal end of the depth guide is adjustable by advancing the lead screw into the threaded tube or reversing the lead screw out of the threaded tube.

41. The aspiration device of claim 40, wherein lead screw is attached to the introducer handle.

42. The aspiration device of claim 40, wherein the lead screw is hollow and the introducer cannula extends through the hollow lead screw.

43. A bone marrow aspiration device comprising:
an aspiration needle including
a flexible aspiration cannula having a proximal end and a distal end, the proximal end including an opening,
an aspiration handle connected to the proximal end of the aspiration cannula, and

a removable blunt stylet having a proximal end and a distal end, the stylet extending through at least a portion of the aspiration cannula from the aspiration handle,

the aspiration cannula forming a channel for aspirating bone marrow when the blunt stylet is removed; and

a depth guide coupled to the aspiration handle, the depth guide configured to control depth of entry of the aspiration cannula into bone.

44. The aspiration device of claim 43, further including a removable introducer stylet having a proximal end and a distal end, the stylet extendable through the aspiration cannula from the cannula handle when the blunt stylet is removed, the distal end of the stylet extendable beyond the distal end of the aspiration cannula and including a sharp tip to penetrate bone.

45. The aspiration device of claim 44, wherein the stiffness of the assembled aspiration cannula and introducer stylet is sufficiently high to allow the aspiration cannula and introducer stylet to penetrate cortical bone when a longitudinal force is applied to the aspiration cannula and introducer stylet in a distal direction.

46. The aspiration device of claim 45, wherein the stiffness of the assembled aspiration cannula and blunt stylet is sufficiently high to allow the aspiration cannula and blunt stylet to penetrate bone marrow when a longitudinal force is applied to the aspiration cannula and blunt stylet in a distal direction.

47. The aspiration device of claim 43, wherein the depth guide is adjustable and includes a lead screw and a threaded receptor, whereby a length of the aspiration cannula that extends beyond a distal end of the depth guide is adjustable by advancing the lead screw into the threaded receptor or reversing the lead screw out of the threaded receptor.

48. The aspiration device of claim 47, wherein the threaded receptor is a threaded tube and the lead screw is attached to the aspiration handle.

49. The aspiration device of claim 48, wherein the lead screw is hollow and the aspircation cannula extends through the hollow lead screw.

50. A method for aspirating bone marrow, the method comprising:

inserting an aspiration needle into bone marrow through an introducer cannula placed in a bone, the aspiration needle including

an aspiration cannula having a proximal end and a distal end, the proximal end including an opening,

an aspiration handle connected to the proximal end of the aspiration cannula, and

a blunt stylet having a proximal end and a distal end, the stylet extending through at least a portion of the aspiration cannula from the aspiration handle;

removing the blunt stylet from the aspiration needle, the aspiration cannula forming a channel for aspirating bone marrow when the stylet is removed;

locking the aspiration cannula to the introducer cannula with a locking mechanism, the aspiration cannula being able to advanced distally relative to the introducer cannula in a controlled manner, the locking mechanism causing the introducer cannula to move proximally with the aspiration cannula when the aspiration cannula is pulled proximally; and

aspirating bone marrow through the channel.

51. The method of claim 45, wherein inserting the aspiration needle includes flexing or bending the assembled aspiration cannula and blunt stylet against cortical bone.

52. The method of claim 51, wherein the locking mechanism includes a screw mechanism and wherein inserting the aspiration needle includes employing

the screw mechanism to advance the aspiration needle distally in a controlled manner.

53. The method of claim 45, wherein aspirating bone marrow includes retracting the aspiration needle from the bone.

54. The method of claim 53, wherein retracting the aspiration needle includes retracting the introducer cannula from the bone by employing the locking mechanism to move the introducer cannula proximally with the aspiration cannula.

55. The method of claim 45, further comprising, before inserting the aspiration needle,

penetrating cortical bone with an introducer needle, the introducer needle including

the introducer cannula having a proximal end and a distal end, each end including an opening,

an introducer handle connected to the proximal end of the introducer cannula, and

an introducer stylet having a proximal end and a distal end, the stylet extending through the introducer cannula from the introducer handle, the distal end of the stylet extending beyond the distal end of the introducer cannula and including a sharp tip to penetrate bone; and

removing the introducer stylet.

56. The method of claim 55, further including advancing the introducer needle into the bone to a selected depth before removing the introducer stylet.

CLAIMS

What is claimed is:

1. A bone marrow aspiration device comprising:

an introducer needle including

an introducer cannula having a proximal end and a distal end, each end including an opening,

an introducer handle connected to the proximal end of the introducer cannula, and

a removable introducer stylet having a proximal end and a distal end, the stylet extending through the introducer cannula from the cannula handle, the distal end of the stylet extending beyond the distal end of the introducer cannula and including a sharp tip to penetrate bone;

an aspiration needle receivable in the introducer cannula when the introducer stylet is removed from the introducer needle, the aspiration needle including

an aspiration cannula having a proximal end and a distal end, the proximal end including an opening and the distal end being closed, the aspiration cannula forming a channel for aspirating bone marrow, and

an aspiration handle connected to the proximal end of the aspiration cannula; and

an adjustable depth guide coupled to the introducer handle, the depth guide configured to control depth of entry of the introducer cannula into bone.

2. The aspiration device of claim 1, wherein the introducer cannula includes plural holes.

3. The aspiration device of claim 2, wherein the holes are near the distal end of the introducer cannula.

4. The aspiration device of claim 2, wherein the aspiration cannula includes a cutout alignable with at least one of the plural holes of the introducer cannula.

5. The aspiration device of claim 4, wherein the distal end of the aspiration cannula is configured to close the opening of the distal end of the introducer cannula.

6. The aspiration device of claim 1, wherein the aspiration needle includes a connector to couple to the introducer needle in an air-tight manner.

7. The aspiration device of claim 1, wherein the depth guide includes a lead screw and a threaded tube, whereby a length of the introducer cannula that extends beyond a distal end of the depth guide is adjustable by advancing the lead screw into the threaded tube or reversing the lead screw out of the threaded tube.

8. The aspiration device of claim 7, wherein lead screw is attached to the introducer handle.

9. The aspiration device of claim 7, wherein the lead screw is hollow and the introducer cannula extends through the hollow lead screw.

10. The aspiration device of claim 1, wherein the depth guide is configured to provide controlled aspiration during retrieval of the aspiration cannula from the bone.

11. The aspiration device of claim 1, wherein the aspiration cannula includes a port in fluid communication with the channel for aspirating bone marrow, the port being near the distal end of the aspiration cannula.

12. The aspiration device of claim 11, wherein the port includes plural side ports along a length of the aspiration cannula.