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(54) Title: SYSTEM AND METHOD FOR ASSOCIATION OF A GUIDING AID WITH A PATIENT TISSUE

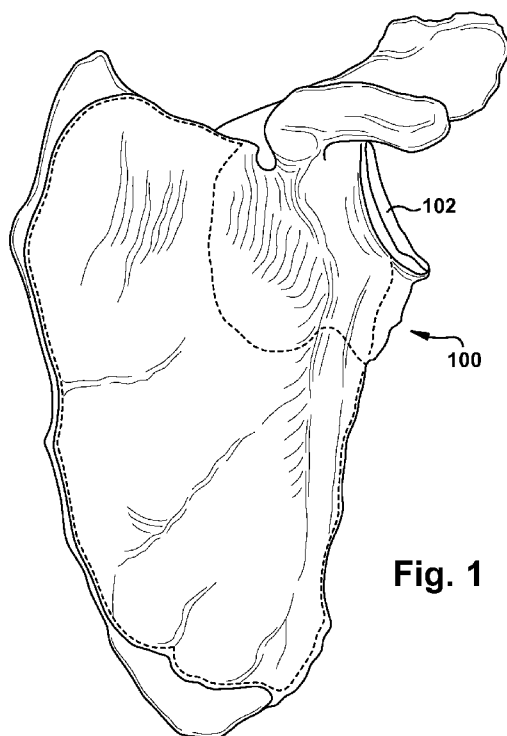


Fig. 1

(57) Abstract: A patient tissue includes a primary patient tissue area and an anatomically differentiated bordering secondary patient tissue area. An apparatus is at least partially customized responsive to preoperative imaging of the patient tissue. Means are provided for mating with the primary patient tissue area in a preselected relative orientation. Means are provided for fixing a first landmark to the primary patient tissue area in at least one of a predetermined marking location and a predetermined marking trajectory. Means are provided for fixing a second landmark to the secondary patient tissue area in at least one of a predetermined marking location and a predetermined marking trajectory. A method of associating a plurality of landmarks with a patient tissue is also provided.

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AMENDED CLAIMS

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Having described the invention, we claim:

1. An apparatus for associating a plurality of landmarks (114) with a patient tissue (100), the patient tissue (100) including a primary patient tissue area (108) and an anatomically differentiated bordering secondary patient tissue area (110), the apparatus being at least partially custom-manufactured responsive to preoperative imaging of the patient tissue (100), the apparatus comprising:

means for mating with the primary patient tissue area (108) in a preselected relative orientation;

means for fixing a first landmark (114) to the primary patient tissue area (108) in at least one of a predetermined marking location and a predetermined marking trajectory; and

means for fixing a second landmark (114) to the secondary patient tissue area (110) in at least one of a predetermined marking location and a predetermined marking trajectory.

2. The apparatus of claim 1, wherein the means for mating with the primary patient tissue area (108) includes means for mating with the secondary patient tissue area (110) in a preselected relative orientation while the means for mating is mated with the primary patient tissue area (108).

3. The apparatus of claim 1, wherein the means for mating with the primary patient tissue area (108) includes:

a base (418) having a lower base surface (520) contoured to mate with both the primary and secondary patient tissue areas (108, 110) in a preselected relative orientation, the lower base surface (520) being spaced apart from an upper base surface (422) by a base body (424); and

wherein the means for fixing a first landmark (114) to the primary patient tissue area (108) includes:

a plurality of base apertures (526) extending between the upper and lower base surfaces (422, 520) through the base body (424), and

a plurality of guiding bosses (428) protruding from the base (418), each guiding boss (428) having a guiding bore (430) extending therethrough, each guiding bore (430) extending collinearly with a corresponding base aperture (526) to permit insertion of a first landmark (114) through the apparatus; and

wherein each guiding bore (430) and corresponding base aperture (526) cooperatively define at least one of the predetermined marking location and the predetermined marking trajectory for the first landmark (114).

4. The apparatus of claim 1, wherein the means for mating with the primary patient tissue area (108) includes:

a base (418) having a lower base surface (520) contoured to mate with the primary patient tissue area (108) in a preselected relative orientation, the lower base surface (520) being spaced apart from an upper base surface (422) by a base body (424); and

wherein the means for fixing a second landmark (114) to the secondary patient tissue area (110) includes:

a stem (1758) having longitudinally separated first and second stem ends (1764, 1766), the first stem end (1764) being attached directly to the base (418) and the stem (1758) extending upward from the base (418), and

at least one spacing arm (1760) attached directly to the second stem end (1766), each spacing arm (1760) being longitudinally spaced from the base (418) and having an arm guide aperture (1768) laterally spaced from the stem (1758), the arm guide aperture (1768) being configured to guide placement of a second landmark (114) at least partially therethrough in at least one of the predetermined marking location and the predetermined marking trajectory, the marking location (838) being in the secondary patient tissue area (110).

5. The apparatus of claim 4, wherein the means for fixing a first landmark (114) to the primary patient tissue area (108) includes a base guide aperture (1762) in the base (418), the base guide aperture (1762) configured to guide placement of a landmark (114) therethrough in at least one of the predetermined marking location and the predetermined marking trajectory, the marking location (838) being in the primary patient tissue area (108).

6. An apparatus for associating a plurality of landmarks (114) with a patient tissue (100), each landmark (114) being associated with the patient tissue (100) in at least one of a predetermined marking location and a predetermined marking trajectory, the patient tissue (100) including a primary patient tissue area (108) and an anatomically differentiated bordering secondary patient tissue area (110), the apparatus being at least partially custom-manufactured responsive to preoperative imaging of the patient tissue (100), the apparatus comprising:

a base (418) having a lower base surface (520) contoured to mate with both the primary and secondary patient tissue areas (108, 110) in a preselected relative orientation, the lower base surface (520) being spaced apart from an upper base surface (422) by a base body (424);

a plurality of base apertures (526) extending between the upper and lower base surfaces (422, 520) through the base body (424); and

a plurality of guiding bosses (428) protruding from the base (418), each guiding boss (428) having a guiding bore (430) extending therethrough, each guiding bore (430) extending collinearly with a corresponding base aperture (526) to permit insertion of a landmark (114) through the apparatus;

wherein each guiding bore (430) and corresponding base aperture (526) cooperatively define at least one of the predetermined marking location and the predetermined marking trajectory for the landmark (114); and

wherein at least one landmark (114) is guided by the apparatus into engagement with a marking location (838) in the primary patient tissue area (108) and at least one landmark (114) is guided by the apparatus into engagement with a marking location (838) in the secondary patient tissue area (110).

7. The apparatus of claim 6, wherein at least one guiding boss (428) protrudes from the upper base surface (422).

8. The apparatus of claim 6, including at least one handling boss (1544) protruding from the base (418), the handling boss (1544) being configured for manipulation by the user to at least partially control a position of the apparatus.

9. The apparatus of claim 8, wherein the handling boss (1544) is a guiding boss (428).

10. The apparatus of claim 8, wherein the handling boss (1544) is shaped to selectively interact with a user-manipulated handling tool.

11. The apparatus of claim 6, wherein the primary patient tissue is at least one of an acetabulum (1652) and a glenoid fossa (102).

12. An apparatus for associating a plurality of landmarks (114) with a patient tissue (100), each landmark (114) being associated with the patient tissue (100) in at least one of a predetermined marking location and a predetermined marking trajectory, the patient tissue (100) including a primary patient tissue area (108) and an anatomically differentiated bordering secondary patient tissue area (110), the apparatus being at least partially custom-manufactured responsive to preoperative imaging of the patient tissue (100), the apparatus comprising:

a base (418) having a lower base surface (520) contoured to mate with the primary patient tissue area (108) in a preselected relative orientation, the lower base surface (520) being spaced apart from an upper base surface (422) by a base body (424);

a stem (1758) having longitudinally separated first and second stem ends (1764, 1766), the first stem end (1764) being attached directly to the base (418) and the stem (1758) extending upward from the base (418); and

at least one spacing arm (1760) attached directly to the second stem end (1766), each spacing arm (1760) being longitudinally spaced from the base (418) and having an arm guide aperture (1768) laterally spaced from the stem (1758), the arm guide aperture (1768) being configured to guide placement of a landmark (114) inserted at least partially therethrough in at least one of the predetermined marking location and the predetermined marking trajectory, the marking location (838) being in the secondary patient tissue area (110).

13. The apparatus of claim 12, wherein the base (418) includes a base guide aperture (1762) configured to guide placement of a landmark (114) inserted at least partially therethrough in at least one of the predetermined marking location and the predetermined marking trajectory, the marking location (838) being in the primary patient tissue area (108).

14. The apparatus of claim 12, wherein at least one guiding boss (428) protrudes from the upper base surface (422).

15. The apparatus of claim 12, including at least one handling boss (1544) protruding from the base (418), the handling boss (1544) being configured for manipulation by the user to at least partially control a position of the apparatus.

16. The apparatus of claim 15, wherein the handling boss (1544) is a guiding boss (428).

17. The apparatus of claim 15, wherein the handling boss (1544) is shaped to selectively interact with a user-manipulated handling tool.

18. The apparatus of claim 12, wherein the primary patient tissue is at least one of an acetabulum (1652) and a glenoid fossa (102).

19. The apparatus of claim 12, wherein the lower base surface (520) is contoured to mate with both the primary and secondary patient tissue areas (108, 110) in a preselected relative orientation.

20. A method of associating a plurality of landmarks (114) with a patient tissue (100), each landmark (114) being associated with the patient tissue (100) in at least one of a predetermined marking location and a predetermined marking trajectory, the patient tissue (100) including a primary patient tissue area (108) and an anatomically differentiated bordering secondary patient tissue area (110), the method comprising the steps of:

providing a landmark guide (416) having a base (418) at least partially custom-manufactured responsive to preoperative imaging of the patient tissue (100), the base (418) having a lower base surface (520) contoured to mate with the primary patient tissue area (108) in a preselected relative orientation;

mating the base (418) of the landmark guide (416) with the primary patient tissue area (108) in a preselected relative orientation;

fixing a first landmark (114) to the primary patient tissue area (108) in at least one of the predetermined marking location and the predetermined marking trajectory; and

fixing a second landmark (114) to the secondary patient tissue area (110) in at least one of the predetermined marking location and the predetermined marking trajectory.

21. The method of claim 20, wherein the step of mating the base of the landmark guide (416) with the primary patient tissue area (108) includes the step of concurrently mating the base (418) of the landmark guide (416) with the secondary patient tissue area (110) in a preselected relative orientation.

22. The method of claim 20, wherein the step of mating the base (418) of the landmark guide (416) with the primary patient tissue area (108) includes the step of providing a base (418) having a lower base surface (520) contoured to mate with both the primary and secondary patient tissue areas (108, 110) in a preselected relative orientation, the lower base surface (520) being spaced apart from an upper base surface (422) by a base body (424); and

wherein the step of fixing a first landmark (114) to the primary patient tissue area (108) includes the steps of:

providing a plurality of base apertures (526) extending between the upper and lower base surfaces (422, 520) through the base body (424), and

providing a plurality of guiding bosses (428) protruding from the base (418), each guiding boss (428) having a guiding bore (430) extending therethrough, each guiding bore (430) extending collinearly with a corresponding base aperture (526) to permit insertion of a first landmark (114) through the apparatus, and

cooperatively defining at least one of the predetermined marking location and the predetermined marking trajectory for the first landmark (114) with each guiding bore (430) and corresponding base aperture (526).

23. The method of claim 20, wherein the step of mating the base of the landmark guide (416) with the primary patient tissue area (108) includes the step of providing a base (418) having a lower base surface (520) contoured to mate with the primary patient tissue area (108) in a preselected relative orientation, the lower base surface (520) being spaced apart from an upper base surface (422) by a base body (424); and

wherein the step of fixing a second landmark (114) to the secondary patient tissue area (110) includes the steps of:

providing a stem (1758) having longitudinally separated first and second stem ends (1764, 1766), the first stem end (1764) being attached directly to the base (418) and the stem (1758) extending upward from the base (418),

providing at least one spacing arm (1760) attached directly to the second stem end (1766), each spacing arm (1760) being longitudinally spaced from the base (418) and having an arm guide aperture (1768) laterally spaced from the stem (1758), and

guiding placement of a second landmark (114) inserted at least partially through the arm guide aperture (1768) in at least one of the predetermined marking location and the predetermined marking trajectory, the marking location (838) being in the secondary patient tissue area (110).

24. The method of claim 23, wherein the step of fixing a first landmark (114) to the primary patient tissue area (108) includes the steps of:

providing a base guide aperture (1762) in the base (418); and

guiding placement of a landmark (114) inserted at least partially through the base guide aperture (1762) in at least one of the predetermined marking location and the predetermined marking trajectory, the marking location (838) being in the primary patient tissue area (108).

25. An apparatus for associating a plurality of landmarks (114) with a patient tissue (100), each landmark (114) being associated with the patient tissue (100) in at least one of a predetermined marking location and a predetermined marking trajectory, and for guiding the removal of a predetermined amount of resection patient tissue and rearrangement of a remaining patient tissue, the apparatus being at least partially custom-manufactured responsive to preoperative imaging of the patient tissue, the apparatus comprising:

a first guide (416) configured to contact the resection patient tissue and the remaining patient tissue and to guide surgical contact with the patient tissue, the first guide (416) comprising:

a first guide base (418) having a lower first guide base surface (520) contoured to mate with both the resection and remaining patient tissues in a preselected relative orientation, the lower first guide base surface (520) being spaced apart from an upper first guide base surface (422) by a first guide base body (424);

at least one first guide landmark guiding aperture (526) extending between the upper and lower first guide base surfaces (422, 520) through the first guide base body (424) to permit insertion of at least one landmark (114) therethrough; and

a plurality of first guide cutting guide apertures (2582) extending between the upper and lower first guide base surfaces (422, 520) through the first guide base body (424) to permit penetration of at least one cutting tool (2584) through the first guide (416);

wherein at least one of the first guide landmark guiding apertures (526) defines at least one of the predetermined marking location and the predetermined marking trajectory for a first landmark (114) and a plurality of the first guide cutting guide apertures (2582) each defines at least one cutting plane location and orientation for a cutting tool (2584) to make at least one resection cut into the patient tissue;

wherein the first guide (416) is configured to guide cutting of the resection patient tissue for removal from the remaining patient tissue.

26. The apparatus of claim 25 including a second guide (416) configured to guide surgical contact with the remaining patient tissue after removal of the resection patient tissue, the second guide (416) comprising:

a second guide base (418) having a lower second guide base surface (520) contoured to mate with the remaining patient tissue in a preselected relative orientation after removal of the resection patient tissue, the lower second guide base surface (520) being spaced apart from an upper second guide base surface (422) by a second guide base body (424);

a plurality of second guide landmark guiding apertures (37) extending between the upper and lower second guide base surfaces (422, 520) through the second guide base body (424) to permit insertion of at least one second landmark (114) through the second guide (416); and

wherein at least one of the second guide landmark guiding apertures (37) defines at least one of the predetermined marking location and the predetermined marking trajectory for at least one of a landmark (114) and a fastener; and

wherein the first guide (416) is configured to cut the resection patient tissue for removal from the remaining patient tissue, the remaining patient tissue is then rearranged to correct two dimensions of deformity, and the second guide (416) is configured to perform at least one of landmarking the correction of a third dimension of deformity and guiding the placement of at least one fastener to retain the remaining patient tissue in a desired final arrangement.

27. The apparatus of claim 26, wherein the second guide (416) includes at least one second guide cutting guide aperture (2582) extending between the upper and lower second guide base surfaces (422, 520) through the second guide base body (424) to permit penetration of a cutting tool (2584) through the second guide (416), the second guide (416) being configured to define at least one cutting plane location and orientation for a cutting tool (2584) to make at least one secondary cut into the patient tissue, the secondary cut being configured to assist with the correction of the third dimension of deformity.

28. The apparatus of claim 25, wherein at least one guiding boss (428) protrudes from at least one of the upper first guide base surface (422) and the upper second guide base surface (422).

29. The apparatus of claim 25, wherein the patient tissue (100) is at least one of a long bone shaft and a long bone head.