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(54) **BIOPSY LOCALIZATION METHOD AND DEVICE**

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(57) **ABSTRACT**

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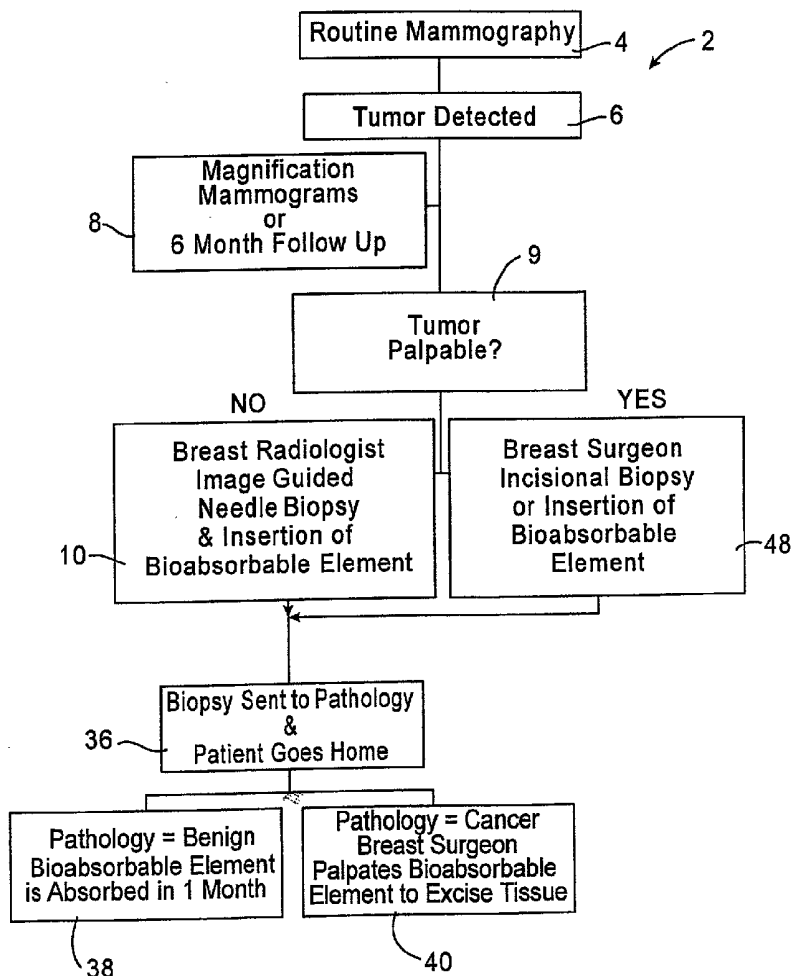
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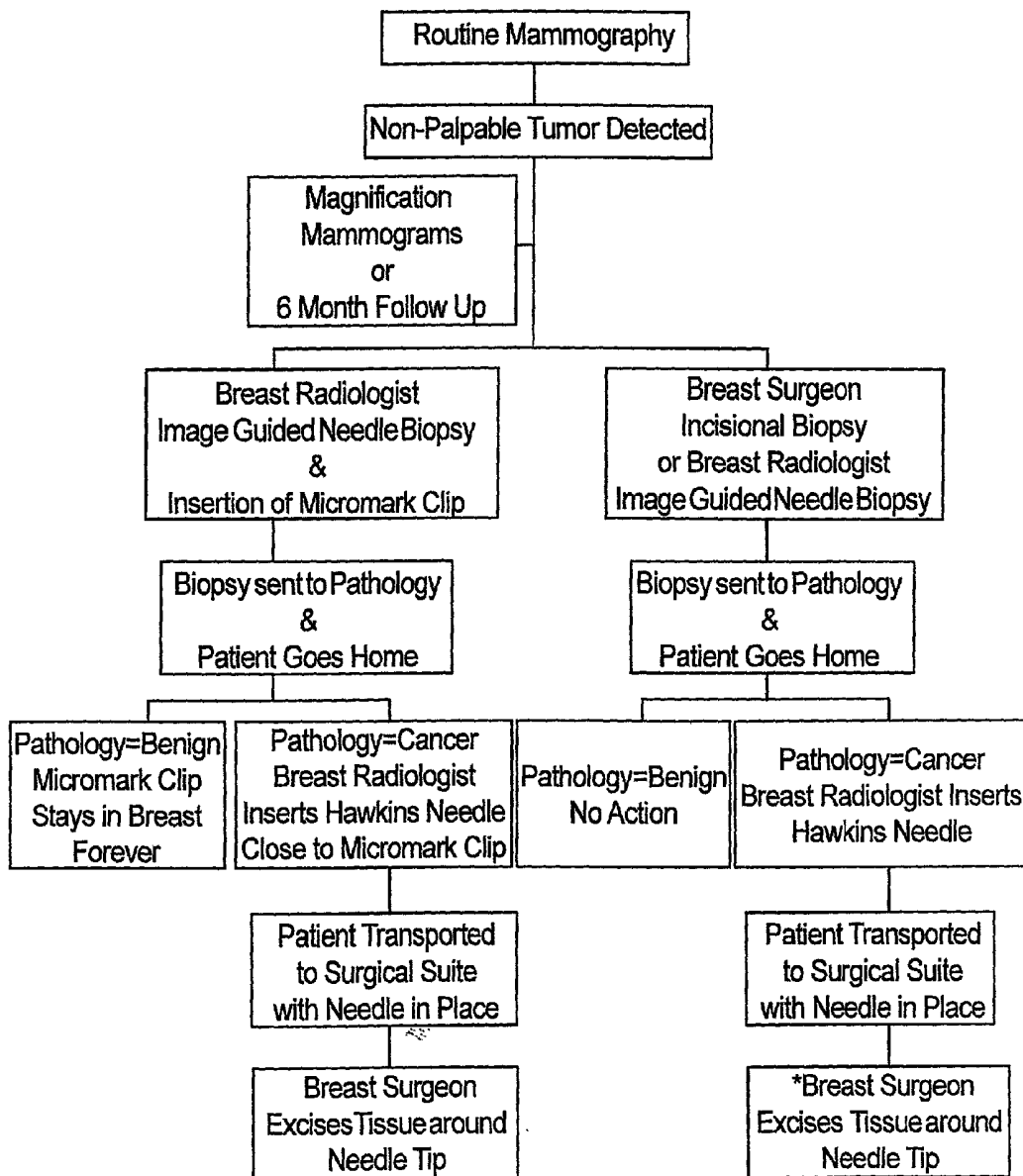
A biopsy localization device made according to the invention includes a bioabsorbable element (34), such as a dehydrated collagen plug, delivered in a pre-delivery state to a soft tissue biopsy site (18) of a patient by an element delivery device (32). The bioabsorbable element preferably swells to fill the biopsied open region (26) and preferably is palpably harder than the surrounding soft tissue at the biopsy site. The bioabsorbable element permits the biopsy site to be relocated by palpation to eliminate the need to use metallic clips during biopsies and often eliminates the need for a return to the radiologist for pre-operative localization. In addition, the bioabsorbable element can be used as a therapeutic tool for treatment of the diseased lesion and for hemostasis.

Related U.S. Application Data

(63) Continuation of application No. 09/336,360, filed on Jun. 18, 1999, now Pat. No. 6,270,464, which is a non-provisional of provisional application No. 60/090,243, filed on Jun. 22, 1998 and which is a non-provisional of provisional application No. 60/092,734, filed on Jul. 14, 1998 and which is a



Genesis Medical: Current State of the Art Treatment
Algorithm for Non-Palpable Lesions



*Some surgeons elect just to use excisional scar and tumor bed to localize area for excision.

(PRIOR ART)
FIG. 1

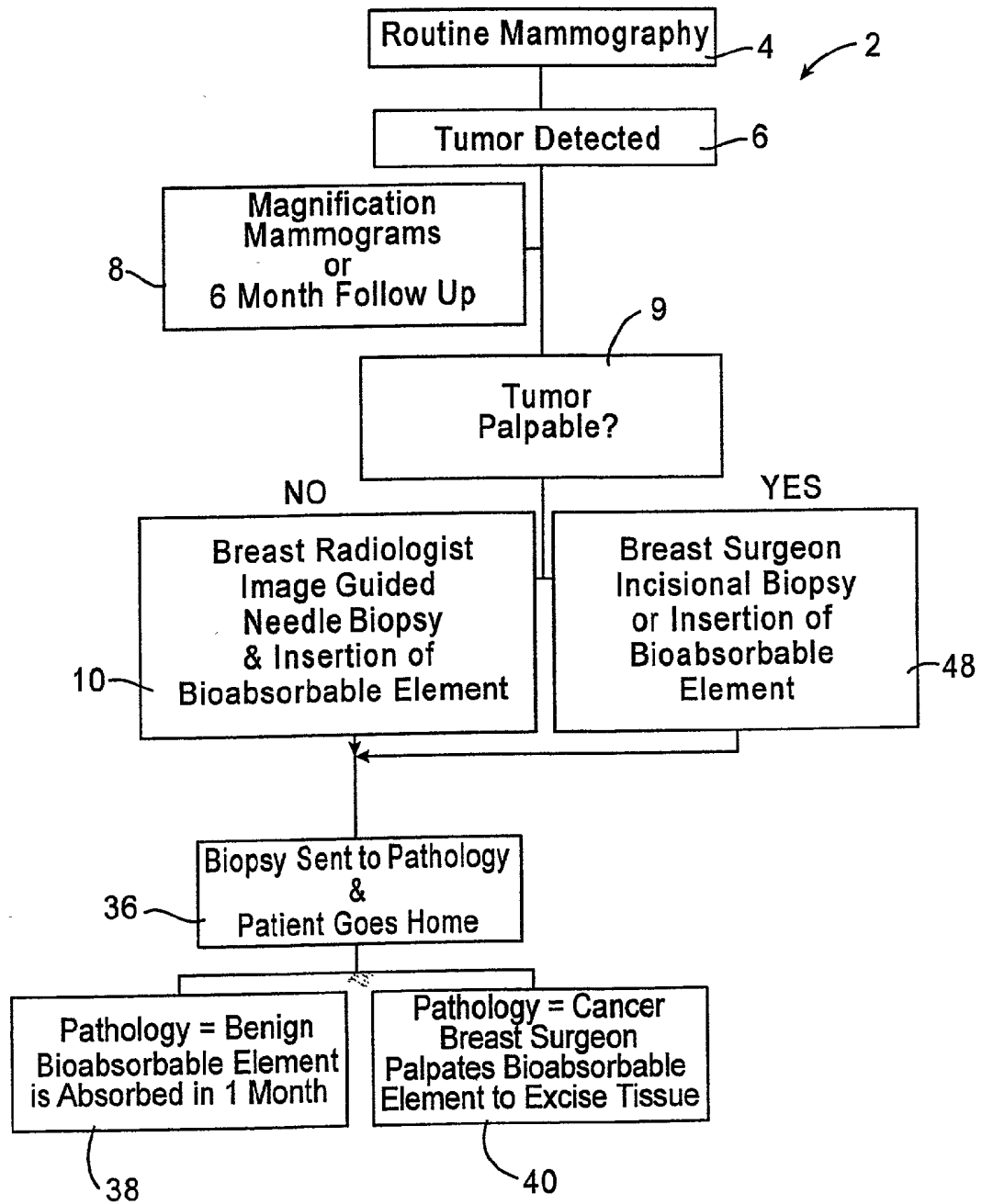


FIG. 2

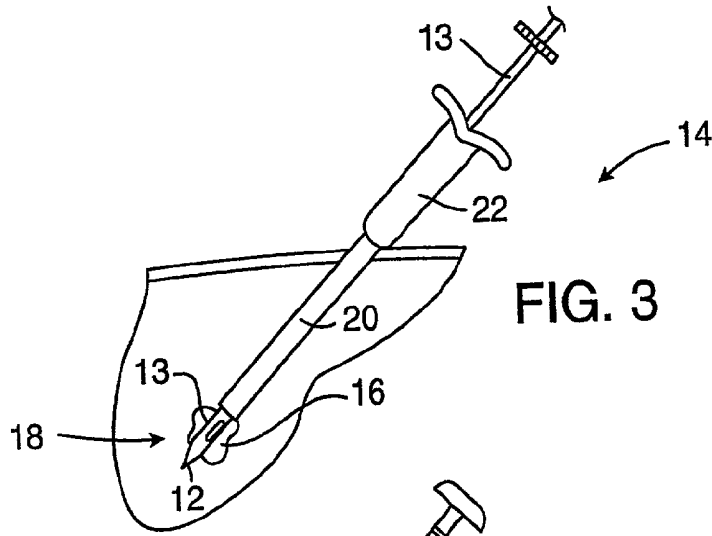


FIG. 3

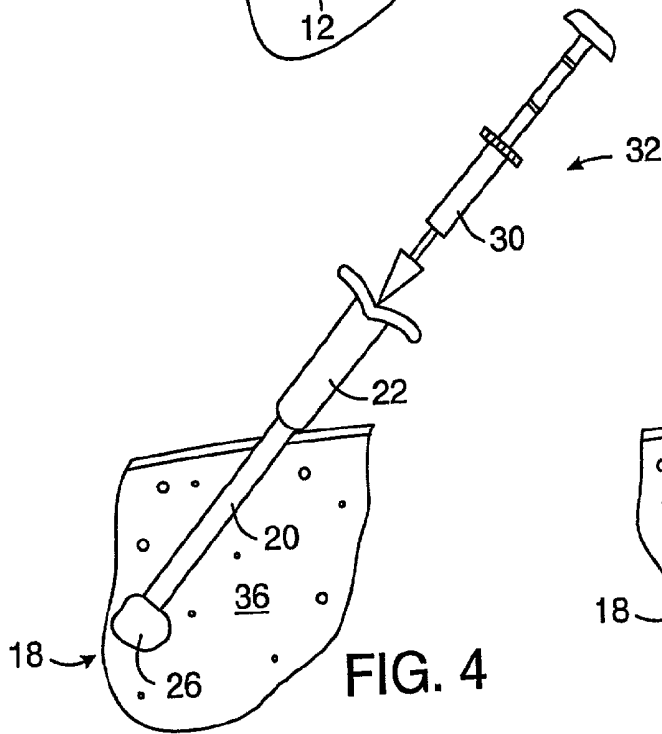


FIG. 4

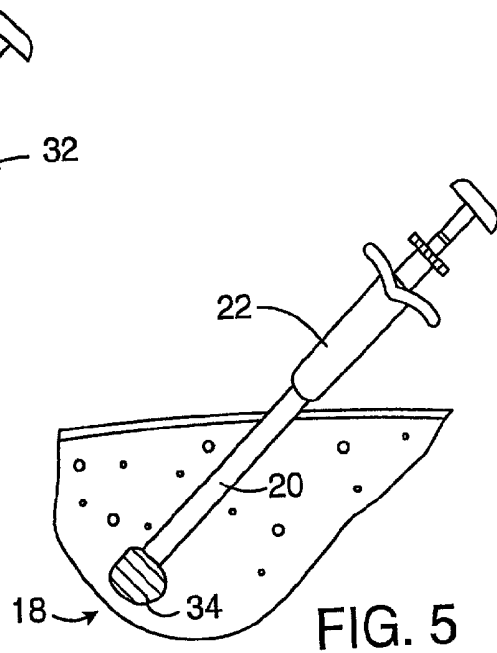


FIG. 5

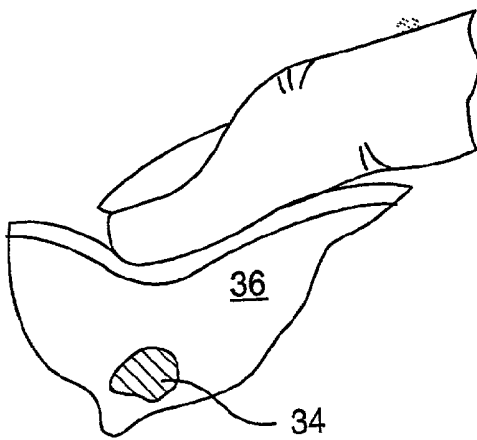


FIG. 6

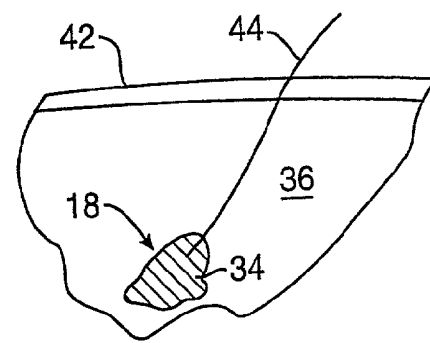


FIG. 7

BIOPSY LOCALIZATION METHOD AND DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of the following Provisional patent applications. Biopsy Localization Device, Application No. 60/090,243, filed Jun. 22, 1998; Biopsy Localization and Hemostasis Device, Application No. 60/092,734, filed Jul. 14, 1998; Device and Method of Biopsy Localization and Hemostasis, Application No. 60/114,863, filed Jan. 6, 1999; and Device and Method of Biopsy Localization, Hemostasis & Cancer Therapy, Application No. 60/117,421, filed Jan. 25, 1999.

BACKGROUND OF THE INVENTION

[0002] In the U.S. alone approximately one million women will have breast biopsies because of irregular mammograms and palpable abnormalities. See **FIG. 1** which diagrams the current treatment algorithm for non-palpable breast lesions. Biopsies can be done in a number of different ways for non-palpable lesions, including surgical excisional biopsies and stereotactic and ultrasound guided needle breast biopsies. In the case of image directed biopsy, the radiologist or other physician takes a small sample of the irregular tissue for laboratory analysis. If the biopsy proves to be malignant, additional surgery (typically a lumpectomy or a mastectomy) is required. The patient then returns to the radiologist a day or two later where the biopsy site (the site of the lesion) is relocated by method called needle localization, a preoperative localization in preparation for the surgery.

[0003] Locating the previously biopsied area after surgical excision type of biopsy is usually not a problem because of the deformity caused by the surgery. However, if the biopsy had been done with an image directed needle technique, as is common, help in relocating the biopsy site is usually needed. One procedure to permit the biopsy site to be relocated by the radiologist during preoperative localization is to leave some of the suspicious calcifications; this has its drawbacks.

[0004] Another way to help the radiologist relocate the biopsy site involves the use of a small metallic surgical clip, such as those made by Biopsys. The metallic clip can be deployed through the biopsy needle, and is left at the biopsy site at the time of the original biopsy. With the metallic clip as a guide, the radiologist typically inserts a barbed or hooked wire, such as the Hawkins, Kopans, Homer, Sadowski, and other needles, back into the patient's breast and positions the tip of the wire at the biopsy site using mammography to document the placement. The patient is then taken to the operating room with the needle apparatus sticking out of the patient's breast. While the clip provides a good indication of the biopsy site to the radiologist during preoperative localization, the clip remains permanently within the 80% of patients with benign diagnoses. Also, because the clip is necessarily attached to a single position at the periphery of the biopsy site, rather than the center of the biopsy site, its location may provide a misleading indication of the location of diseased tissue during any subsequent medical intervention. In addition, the soft nature of breast tissue permits the tip of the barbed or hooked needle to be relatively easily dislodged from the biopsy site. The clip is also relatively expensive.

[0005] Another localization method involves the use of laser light from the tip of an optical fiber connected to a laser. A pair of hooks at the tip of the optical fiber secures the tip at the biopsy site; the glow indicates the position of the tip through several centimeters of breast tissue. This procedure suffers from some of the same problems associated with the use of barbed or hooked wires. Another preoperative localization procedure injects medical-grade powdered carbon suspension from the lesion to the skin surface. This procedure also has certain problems, including the creation of discontinuities along the carbon trail.

SUMMARY OF THE INVENTION

[0006] The present invention is directed to a biopsy localization method and device which uses a locatable bioabsorbable element left at the biopsy site so that if testing of the biopsy sample indicates a need to do so, the biopsy site can be relocated by finding the bioabsorbable element. This eliminates the need to use of metallic clips during biopsies and often eliminates the need for a return to the radiologist for preoperative needle localization. In addition, the bioabsorbable element can be used as a therapeutic tool for treatment of the diseased lesion and for hemostasis.

[0007] A biopsy localization device made according to the invention includes a bioabsorbable element delivered in a pre-delivery state to a soft tissue biopsy site of a patient by an element delivery device. The bioabsorbable element may be palpably harder than the surrounding soft tissue at the biopsy site when in the post-delivery state.

[0008] One preferred material used as the bioabsorbable element is a dehydrated collagen plug. This type of plug may swell and is palpable for subsequent location by the surgeon. The collagen plug may not swell at all. In some situations, such as with small breasted women or where the biopsy site is close to the surface, a non-swelling bioabsorbable material, such as a round pellet of PGA, can be used instead of a swelling bioabsorbable material. The bioabsorbable material can also be made so that it is absorbed quickly to produce a local tissue inflammation; such a localized inflammation can be used to locate the biopsy site instead of location by palpation. Instead of leaving, for example, a collagen plug, a PGA pellet or a bioabsorbable suture material at the biopsy site for location by palpation or inflammation, a length of bioabsorbable suture material, a collagen filament, or other bioabsorbable material extending from the biopsy site out through the skin can be used. In this case the surgeon can follow the bioabsorbable suture material to the biopsy site in a manner similar to that used with Hawkins needles. In other cases, such as in the case of a deeply located lesion or large breast, the bioabsorbable material may need to be located by the radiologist, by for example, ultrasound or mammography. In any event the bioabsorbable material will typically be absorbed within about a month of placement. The invention thus eliminates the use of metal clips during biopsies and usually eliminates the need for return to the radiologist for preoperative localization.

[0009] While the primary use of the device is intended to localize the site of needle biopsies for possible future surgical excision, the device may also be useful in marking the site of surgical excisional biopsies. For example, during a wide surgical excision for cancer diagnosed by a recent

surgical excisional biopsy, surgeons frequently have difficulty in determining the precise relationship of the previously excised tissue to the surgical wound. Therefore, more tissue is removed than might have been removed had the exact location of the previous lesion been more definite. With the present invention, a bioabsorbable element may be inserted into the biopsy site during a surgical excisional biopsy before the wound is closed to mark the site for potential wide excision should the biopsy reveal cancer. Alternatively, a bioabsorbable element may be placed at the biopsy site using a delivery device by partially or completely closing the wound and then depositing the bioabsorbable element through the delivery device and removing the delivery device through the closed incision. The presence of the palpable marker within the previous excisional biopsy site would allow the surgeon to more easily and confidently remove tissue around this site, and preserve more normal breast tissue.

[0010] Another use of the device is to primarily localize a non-palpable lesion prior to surgical excisional biopsy. Instead of using the needle/wire apparatus which has a tendency to migrate and become dislodged with traction, the palpable marker may be inserted into the suspicious area of the breast under mammographic or ultrasonic guidance immediately prior to the surgical excisional biopsy. This would provide a palpable locator for the surgeon as described above. In this instance, the marker would only need to be palpable, and not necessarily bioresorbable, since the intent would be to remove it in all cases.

[0011] In addition to permitting the biopsy site to be located by subsequent palpation or other means, the invention also can provide hemostasis and therapeutic benefits. Since the bioabsorbability can be varied from a day or two to a year or more, the material may be used to treat the diseased tissue and not just locate it. Some current therapies include radiation, chemotherapy, gene therapy as well as other technologies and therapies. Because the bioabsorbability can be easily varied, a medium can be placed into the bioabsorbable element and be externally excited or triggered in those cases where the biopsy results are malignant. Further, the bioabsorbability concept can be used for future implantation of a therapeutic agent. For example, if the bioabsorbable element is a dehydrated collagen, this material could be used as a reservoir for, for example, delivery of materials that effect chemotherapy, brachytherapy, etc. Once the laboratory results are received and show the biopsy is malignant and therapy is required, by surgical excision or otherwise, the physician may inject, for example, a radiation pellet, a chemotherapeutic agent or a gene therapeutic agent into or adjacent to the bioabsorbable element for direct treatment of the diseased tissue.

[0012] The change in the bioabsorbable element can be via one of several ways, such as hydration or desiccation, change in temperature, electrical stimulation, magnetic stimulation, chemical or physical reaction with another material, additives, enzymatic reactions, ionization, electrical charges, absorption, as well as other means. The invention may employ one or more of these techniques or measures or others, to change the consistency, hardness and or size of the bioabsorbable element between its deployed and non-deployed states. The visual detectability of the bioabsorbable element may be aided by the use of a coloring agent, such as methylene blue or some other dye. The

Radiographic detectability of the element may be enhanced by a radiopaque marker. As well, ultrasonic detectability may be enhanced by special treatment of the bioresorbable element.

[0013] The bioresorbable element may have margins which are roughened so as to prevent migration within the tissues. Filaments extending from the margins of the bioresorbable element may be utilized also to stabilize the position of the device within the cavity. The filaments may or may not be composed of the same material as the bioresorbable element.

[0014] The provision of hemostasis helps to lessen the bleeding and swelling within and about the biopsy site. This can be accomplished by physical or chemical means. That is, the device may swell so that it essentially fills the biopsy cavity or the device may have a chemical reaction with blood or blood products to cause effective blood clotting, or both. Other methods for causing local hemostasis are also possible with the invention.

[0015] Other features and advantages of the invention will appear from the following description in which the preferred embodiments and methods have been set forth in detail in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. 1 is a flow diagram of a conventional treatment algorithm for nonpalpable breast lesions;

[0017] FIG. 2 is a flow diagram of a treatment algorithm according to the present invention;

[0018] FIG. 3 is a simplified view illustrating a biopsy needle assembly obtaining a tissue sample of an abnormality at a target site;

[0019] FIG. 4 illustrates the main housing and sheath of the needle biopsy assembly left in place after the tissue sample has been removed leaving a biopsied open region at the target site;

[0020] FIG. 5 illustrates the barrel of the delivery device of FIG. 4 inserted into the main housing of the biopsy needle assembly and the plunger depressed injecting the bioabsorbable element into the biopsied open region, thus effectively filling the biopsied open region at the target site;

[0021] FIG. 6 illustrates the location of the bioabsorbable element of FIG. 5 with the surgeon using his or her fingers; and

[0022] FIG. 7 illustrates a bioabsorbable thread extending from the bioabsorbable element of FIG. 5 up through the patient's skin, the thread being delivered to the bioabsorbable element using the delivery device of FIGS. 4 and 5.

DESCRIPTION OF THE SPECIFIC EMBODIMENTS

[0023] FIG. 2 illustrates a treatment algorithm 2 according to the present invention. As a result of a routine mammography 4, a tumor or other abnormality may be detected as at 6. The typical response will often include additional magnification mammograms or a follow-up mammogram scheduled for some time in the future, such as six months. This is indicated at 8. If the tumor is not palpable, see 9, an image guided needle biopsy by a breast radiologist

is typically conducted as at **10**. Image guided needle biopsies can be done in a number of ways. Presently, stereotactic (x-ray) and ultrasound guided needle biopsies are commonly used, primarily because of their accuracy, speed and minimal trauma to the patient. Stereotactic needle biopsies typically use a stereotactic table, such as made by Fisher or Lorad, which provides mammography (x-ray) guidance to a biopsy needle assembly. Ultrasound guided biopsies can be conducted with any one of a number of commercially available instruments. An exemplary biopsy needle assembly **14**, illustrated in **FIG. 3**, includes a biopsy needle **13** passing through a sheath **20** extending from a hollow main housing **22**. The tip **12** of biopsy needle **13** of biopsy needle assembly **14** is automatically inserted to the abnormality **16** at the target site **18**. Biopsy needle **13** has a laterally directed side opening **24** adjacent to tip **12** used to capture a tissue sample of abnormality **16**. Once the tissue samples have been obtained, the removed tissue creates a biopsied open region **26** at target site **18**. See **FIG. 4**. Following the removal of biopsy needle **13** from sheath **20** and main housing **22**, the barrel **30** of a bioabsorbable element delivery device **32** is inserted through main housing **22** and into sheath **20**. Barrel **30** contains a bioabsorbable element **34**, see **FIG. 5**. Bioabsorbable element **34** is, in this preferred embodiment, a plug of dehydrated collagen, such as that sold by several companies such as Davol, Datascope, Integra Life Sciences, Collagen Matrix, Vascular Solutions, et al. Bioabsorbable element **34** may swell on contact with an aqueous liquid within biopsied open region **26** and substantially fills the biopsied open region as suggested in **FIG. 5**. In this preferred embodiment, bioabsorbable element **34** is transformed from its pre-delivery state within barrel **30** to its post-delivery state at region **26** and in the process swells and becomes somewhat softer in its post-delivery state than in its pre-delivery state. However, in its post-delivery state, bioabsorbable element **34** is palpably harder, preferably at least about **1.5** times harder, than the surrounding soft tissue, typically breast tissue **36**. This permits bioabsorbable element **34** at the target site **18** to be relocated by palpation of the patient by the physician, see **FIG. 6**, to find the bioabsorbable element **6** and as discussed in more detail below.

[0024] A bioabsorbable element could be made of materials other than collagen and could be in a form other than a solid, relatively hard plug in its pre-delivery state. For example, bioabsorbable element **34** in its pre-delivery state within barrel **30** could be in a liquid or otherwise flowable form; after being deposited at open region **26** at target site **18**, the bioabsorbable element could change to become palpably harder than the surrounding tissue **36** to permit subsequent relocation of target site **18** by palpation. In some situations, it may be desired that bioabsorbable element **34** not change its size or hardness between its pre-delivery state and its post-delivery state, such as being palpably harder than the surrounding tissue **36** in both states. In a preferred embodiment, transformation of bioabsorbable element **34** is by contact with an aqueous liquid.

[0025] However, transformation of the bioabsorbable element, which can be in terms of, for example, hardness, texture, shape, size, or a combination thereof, can be due to other factors, such as application of thermal energy, radiation, magnetic energy, etc.

[0026] Returning again to **FIG. 2**, it is seen that after insertion of bioabsorbable element **34**, the biopsy sample is

sent to pathology for evaluation at **36**. If the pathology report, which is available a day or two after the biopsy, is benign, the patient is so informed and the bioabsorbable element simply is absorbed by the patient within, for example, a month as at **38**. If the pathology report is positive, so that cancer is found, the biopsied open region **26** at the target site **18** is located by the surgeon by palpation as suggested by **FIG. 6**. After finding the target site by palpation, which eliminates the need for preoperative localization by the radiologist, appropriate medical treatment, such as excisional surgery, can be performed.

[0027] If the tumor is palpable, the surgeon may choose to make a direct incisional biopsy as at **48**. According to the present invention, bioabsorbable delivery device **32** could be used to place bioabsorbable element **34** at the site of the incisional biopsy. After removal of delivery device **32**, the incision would be closed, the biopsy sample would be sent to pathology and the patient would go home with the procedure preceding as discussed above, starting with item **36**.

[0028] It may be preferred that bioabsorbable element **34** also act as a hemostatic agent to stop bleeding at site **18** by virtue of physical means, by filling or substantially filling open region **26**, as well as chemical means through the chemical interaction, such as coagulation, with blood components. In addition, bioabsorbable element **34** could be covered by a non-hemostatic degradable outer layer so that hemostasis or other action is delayed until the outer layer has been eroded. In some situations, it may be necessary or at least desirable to shield the bioabsorbable element from the blood or other body fluids until after the bioabsorbable element is in place at target site **18**. This could be accomplished by, for example, physically isolating the bioabsorbable element from body fluids by using a removable physical barrier during delivery of the bioabsorbable element. Alternatively, a bioabsorbable coating or layer, as described above, may be used. The bioabsorbable element may be changed from its pre-delivery state to its post-delivery state in a variety of manners including hydration, changing the temperature, electrical stimulation, magnetic stimulation, chemical reaction with a stimulating agent, physically interaction with an activating member (such as a knife blade which could be used to slice open a capsule containing the bioabsorbable element), by ionizing the bioabsorbable element, or by absorption or adsorption of a fluid by the bioabsorbable element.

[0029] The invention may also be used to medically treat the patient. That is, the bioabsorbable element could include a therapeutic element which would be activated only if the pathology report indicated the need for the medical treatment. Various ways of activating an agent in a bioabsorbable element could be used, such as injecting a radiation-emitting element at the vicinity of the target site, externally irradiating the target site, providing a triggering substance to the target site, manual pressure, photodynamic therapy, sclerosing chemistry, vibrational therapy, ultrasound, and the like. Alternatively, the bioabsorbable element could be made so that it includes no such activating agent; rather, medical treatment could be provided by, for example, delivery of a chemotherapy agent, a radiation emitting element, thermal energy, electrical energy, vibrational energy, gene therapy, vector therapy, anti-angiogenesis therapy. To facilitate the delivery, the bioabsorbable element may contain a radio-

paque marker or may have properties to aid in detecting it by ultrasound, in addition to being palpable.

[0030] An important use for the invention is in the treatment of breast cancer. In one embodiment, it is desirable that bioabsorbable element **34** in its post-delivery state have a hardness of at least about one and a half times that of breast tissue so that it is palpably harder than the surrounding tissue. Also, it is desired that bioabsorbable element **34**, in one embodiment, swells from its pre-delivery state to its post-delivery state so to fill or at least substantially fills open region **26**. To achieve this it is preferred that bioabsorbable element **34** swells about 50 to 1500%, and more preferably about 100 to 300%, from the pre-delivery state to the post delivery state, typically when placed in contact with an aqueous liquid. It is preferred that the bioabsorbable element has a longest dimension of at least about 0.5 cm in its post-delivery state to aid its location by palpation.

[0031] While the bioabsorbable element is preferably made of collagen in one embodiment, the bioabsorbable element can include, for example, one or more of the following materials; polyactic and polyglycolic acids, polyorthoesters, resorbable silicones and urethanes, lipids, polysaccharides, starches, ceramics, polyamino acids, proteins, hydrogels and other gels, gelatins, polymers, cellulose, elastin, and the like.

[0032] In some situations it may be desired to use a bioabsorbable filament **44** extending from bioabsorbable element **34** through the patient's skin **46** as shown in FIG. 7. This can be accomplished by delivering bioabsorbable filament **44** through sheath **20** as bioabsorbable element **34** is injected into region **26** at target site **18**. In some situations it may not be possible or desirable to use bioabsorbable element **34**; in those situations it may be useful to provide for only bioabsorbable filament **44** extending from target site **18** to above the patient's skin **46**.

[0033] While it is presently preferred that bioabsorbable element delivery device **32** be guided through a portion of needle assembly **14**, that is sheath **20** and main housing **22**, in some situations it may be useful to cover sheath **20** with an outer sheath which would be left in place after the biopsy sample has been removed and the entire biopsy needle assembly **14** has been removed. The sheath left in place would then be used to guide barrel **30** of delivery device **32** to target site **18**. Of course, delivery device **32** could take a number of different forms such as a syringe containing fluid or paste that is injected through a needle or through the housing **22** and sheath **20** or through an outer sheath. Alternatively, other delivery devices could be employed for delivery of bioresorbable element **34**.

[0034] The invention has applicability toward the correction of a defect that is caused by breast tissue removal for biopsy or diseased tissue removal. Collagen is often placed in the body where it is eventually replaced by human autogenous tissue. Hence, the invention could be used for the repair of tissue that has been damaged due to tissue removal. The delivery device described heretofore could be used for installing a material (synthetic or mammalian) into the cavity for such a cosmetic or reconstructive repair. The material would typically be an effectively non-bioabsorbable material, such as a silicon gel-filled capsule or bag.

[0035] Modification and variation can be made to the disclosed embodiments without departing from the subject of the invention as defined in the following claims.

[0036] Any and all patents, patent applications, and printed publications referred to above are incorporated by reference.

What is claimed is:

1. A biopsy localization device comprising:

a bioabsorbable element in a pre-delivery state prior to its delivery to a soft tissue biopsy site of a patient; and

said bioabsorbable element being of a material which is in a post-delivery state at the biopsy site, the bioabsorbable element being palpably harder than the surrounding soft tissue at the biopsy site when in the post-delivery state.

2. The device according to claim 1 further comprising a delivery device for delivering the bioabsorbable element in the predelivery state to a soft tissue biopsy site.

3. The device according to claim 1 wherein the bioabsorbable element is of a different hardness in the post-delivery state as in the pre-delivery state.

4. The device according to claim 1 wherein the bioabsorbable element has a hardness of at least about 1.5 times as hard as breast tissue in the post-delivery state.

5. The device according to claim 1 wherein the bioabsorbable element swells about 50 to 1500 percent from the pre-delivery state to the post-delivery state when placed in contact with an aqueous liquid.

6. The device according to claim 1 wherein the bioabsorbable element has a first shape in the pre-delivery state and a second shape in the post-delivery state.

7. The device according to claim 1 wherein the bioabsorbable element has one consistency in the pre-delivery state and a different consistency in the post-delivery state.

8. The device according to claim 1 wherein the bioabsorbable element has a longest dimension of at least about 0.5 cm when in the post-delivery state.

9. The device according to claim 1 wherein the bioabsorbable element made of collagen.

10. The device according to claim 1 wherein the bioabsorbable element comprises a therapeutic agent.

11. The device according to claim 10 wherein the therapeutic agent comprises at least a chosen one of a chemotherapeutic agent, a radiation agent and a gene therapy agent.

12. The device according to claim 1 wherein the bioabsorbable element comprises reservoir means for subsequently receiving a therapeutic agent.

13. The device according to claim 12 wherein the reservoir means comprises reservoir means for receiving a chemotherapy agent.

14. The device according to claim 1 wherein the bioabsorbable element comprises a hemostatic agent.

15. The device according to claim 1 wherein the bioabsorbable element comprises at least one of the following materials: polyactic and polyglycolic acids, polyorthoesters, resorbable silicones and urethanes, lipids, collagens, polysaccharides, starches, ceramics, polyamino acids, proteins, hydrogels and other gels, gelatins, polymers and cellulose.

16. The device according to claim 1 wherein the bioabsorbable element changes from the pre-delivery state to the post-delivery state upon contact with an aqueous environment.

17. The device according to claim 1 wherein the bioabsorbable element is physically different in its pre-delivery state than in its post-delivery state.

18. The device according to claim 1 wherein the bioabsorbable element comprises a bioabsorbable filament.

19. The device according to claim 1 further comprising a marker element located generally centrally within the bioabsorbable element.

20. The device according to claim 19 wherein the marker element is a radiopaque marker element.

21. The device according to claim 19 wherein said marker element comprises a chosen one of a permanent marker element and a temporary marker element.

22. A biopsy localization method comprising:

taking a tissue sample from a biopsy site within a patient;

positioning a bioabsorbable element at the biopsy site at the time of the taking of the tissue sample;

testing the tissue sample; and

if the testing indicates a need to do so relocating the biopsy site by finding the bioabsorbable element.

23. The method according to claim 22 wherein the positioning step is carried out using said bioabsorbable element and a radiopaque marker.

24. The method according to claim 23 wherein the relocating step is carried out using a radiographic technique.

25. The method according to claim 23 wherein the positioning step is carried out using a chosen one of a permanent radiopaque marker and a temporary radiopaque marker.

26. The method according to claim 22 wherein the relocating step is carried out by at least one of:

palpation of the patient to feel the bioabsorbable element;

locating inflammation at the biopsy site caused by the bioabsorbable element;

following a bioabsorbable thread, the thread extending from the patient's skin to the bioabsorbable element; and

remotely visualizing the bioabsorbable element.

27. The method according to claim 26 wherein the remotely visualizing step is carried out by at least a chosen one of ultrasound, MRI and mammography.

28. The method according to claim 22 wherein the tissue sample taking step is carried out using a needle biopsy technique.

29. The method according to claim 22 wherein the tissue sample taking step is carried out using a surgical excisional biopsy technique.

30. The method according to claim 22 wherein the tissue sample taking step is carried out within a soft tissue.

31. The method according to claim 22 further comprising the step of selecting the bioabsorbable element so that after positioning at the target site, the bioabsorbable element has a hardness of at least about 1.5 times as hard as the surrounding tissue.

32. The method according to claim 22 further comprising selecting a hemostatic bioabsorbable element and providing hemostasis at the target site by the hemostatic bioabsorbable element.

33. The method according to claim 32 wherein the hemostasis providing step is provided by at least one of mechanical or chemical hemostatic techniques.

34. The method according to claim 32 further comprising the step of effectively preventing blood from contacting the hemostatic bioabsorbable element until the hemostatic bioabsorbable element is positioned at the target site.

35. The method according to claim 34 wherein the effectively preventing step is carried out using a hemostatic bioabsorbable element having a non-hemostatic degradable outer layer so the hemostasis providing step is a time-delayed hemostasis providing step.

36. The method according to claim 34 wherein the effectively preventing step includes the step of physically isolating the hemostatic bioabsorbable element from contact with blood until it is at the biopsy site.

37. The method according to claim 22 wherein the bioabsorbable element positioning step is carried out by at least one of:

injecting a flowable bioabsorbable element through a hollow member;

pushing a nonflowable bioabsorbable element through a hollow member; and

guiding a solid bioabsorbable element to the target site.

38. The method according to claim 37 wherein the flowable bioabsorbable element injecting step is carried out using a biopsy needle.

39. The method according to claim 22 further comprising the step of changing the bioabsorbable element from a pre-delivery state prior to the positioning step to a post-delivery state after the positioning step.

40. The method according to claim 39 wherein the changing step is carried out by at least one of the following: hydration, changing temperature, electrical stimulation, magnetic stimulation, chemical reaction with a first additional material, physical interaction with a second additional material, ionization, absorption and adsorption.

41. The method according to claim 27 further comprising the step of placing a marker element at a generally central location within the bioabsorbable element at the target site.

42. The method according to claim 41 wherein the placing step takes place simultaneously with the positioning step.

43. The method according to claim 41 wherein the placing step is carried out using a radiopaque marker element.

44. The method according to claim 41 wherein the biopsy site relocating step comprises the step of remotely visualizing the marker element.

45. A medical treatment method comprising:

taking a tissue sample from a biopsy site within a patient;

positioning a bioabsorbable element at the biopsy site at the time of the taking of the tissue sample;

testing the tissue sample;

if the testing indicates a need to do so, and medically treating the biopsy site.

46. The method according to claim 45 wherein the medically treating step comprises activating an agent carried by the bioabsorbable element.

47. The method according to claim 46 wherein the activating step is carried out by at least one of:

injecting a radiation-emitting element at the vicinity of the target site;

externally irradiating the target site; and

providing a triggering substance to the agent.

48. The method according to claim 45 wherein the medically treating step comprises delivering a therapeutic agent to the target site.

49. The method according to claim 48 wherein the delivering step is carried out using at least one of:

a chemotherapy agent;

a radiation-emitting element;

thermal energy;

ionization energy;

gene therapy;

vector therapy;

electrical therapy;

vibrational therapy; and

anti-angiogenesis.

50. The method according to claim 45 further comprising the step of relocating the biopsy by finding the bioabsorbable element.

51. The method according to claim 50 wherein the relocating step is carried out prior to the medically treating step.

52. The method according to claim 51 wherein the medical treating step comprises removal of tissue.

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摘要(译)

根据本发明制造的活组织检查定位装置包括生物可吸收元件 (34) , 例如脱水胶原塞, 通过元件输送装置 (32) 以预交付状态输送到患者的软组织活检部位 (18) 。) 。生物可吸收元件优选地膨胀以填充活检开口区域 (26) , 并且优选地比活检部位处的周围软组织明显更硬。生物可吸收元件允许通过触诊重新定位活检部位以消除在活组织检查期间使用金属夹的需要, 并且通常消除了返回放射科医师进行术前定位的需要。此外, 生物可吸收元件可用作治疗病变病灶和止血的治疗工具。

