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### Ligament revision system

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#### Abstract

A device and system for inserting and impacting bone dowel allografts or bone chips into a bone tunnel. The surgical impacting system includes a surgical tamp having a proximal end and a distal end with an elongated shaft extending therebetween. The surgical tamp has an inner channel extending therethrough from the proximal end to the distal end. The distal end of the surgical tamp can have a distal tip. The surgical tamp may have a handle at the proximal end or a proximal tip at the proximal end. The surgical tamp may also have one or more slots extending through the exterior surface of the elongated shaft and into the inner channel. The surgical tamp can be configured for insertion into a delivery tube. The delivery tube serves the purpose of containing a bone dowel or bone chips therein for smooth insertion into the joint.

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## Background/Summary

CROSS-REFERENCES TO RELATED APPLICATIONS (1) This application is a national stage application under 35 U.S.C. 371 based on international patent application PCT/US19/36951 filed on Jun. 13, 2019, which claims priority to U.S. Provisional Patent Application Ser. No. 62/689,391, filed on Jun. 25, 2018.

## BACKGROUND OF THE INVENTION

### 1. Field of the Invention

(1) The present invention is directed generally to a surgical system and, more particularly, to a device and system for inserting and impacting bone dowel allografts or bone chips into a bone tunnel.

### 2. Description of Related Art

(2) In instances where a failed ligament reconstruction needs to be revised, the bone loss incurred after removing the failed graft or fixation hardware may be too significant to perform the revision in a single stage. Therefore, it is necessary to first address the bone loss before reconstructing the ligament in a second stage. In order to address the bone loss, a bone dowel or bone chips are inserted into the bone tunnel (having the bone loss). After time has passed and the bone has healed, the failed ligament reconstruction can be revised.

(3) Conventional bone dowels are cannulated to interface with a guide pin which aids in navigating

the dowel through the joint into the tunnel. When placed over the guide pin, there is no cannulated tamp or impaction device that can insert the dowel into the tunnel. Surgeons will either use an available device 1 to impact the edges of the bone dowel 2, as shown in FIG. 1, or remove the guide pin and insert the dowel 2 without a guide, as shown in FIG. 2. There are resulting issues/problems with these conventional bone dowels, including the edges of the bone dowel allograft can fracture and crumble during insertion, or without a guide, the bone dowel allograft can fracture and crumble during insertion. Additionally, without a guide, the bone dowel allograft is not properly oriented to be inserted into the tunnel. Another issue is that some surgeons struggle to insert the bone dowel through the skin incision and guide it past the knee structures to the femoral tunnel.

(4) Therefore, there is a need for a device and system for inserting and impacting bone dowels and bone chips into a bone tunnel without the associated problems/issues noted above.

(5) Description of the Related Art Section Disclaimer: To the extent that specific patents/publications/products are discussed above in this Description of the Related Art Section or elsewhere in this disclosure, these discussions should not be taken as an admission that the discussed patents/publications/products are prior art for patent law purposes. For example, some or all of the discussed patents/publications/products may not be sufficiently early in time, may not reflect subject matter developed early enough in time and/or may not be sufficiently enabling so as to amount to prior art for patent law purposes. To the extent that specific patents/publications/products are discussed above in this Description of the Related Art Section and/or throughout the application, the descriptions/disclosures of which are all hereby incorporated by reference into this document in their respective entirety(ies).

## SUMMARY OF THE INVENTION

(6) Embodiments of the present invention are directed to a device and system for inserting and impacting bone dowels and bone chips into a bone tunnel. According to one aspect, the present invention is a surgical impacting system. The system includes a surgical tamp having a proximal end and a distal end with an elongated shaft extending therebetween. The system includes a handle at the proximal end and a cylindrical distal tip at the distal end. The system additionally has an inner channel extending at least partially through the elongated shaft from the proximal end to the distal end.

(7) According to another aspect, the system includes a surgical tamp having a proximal end and a distal end with an elongated shaft extending therebetween. The system also includes a cylindrical proximal tip at the proximal end and a cylindrical distal tip at the distal end. The system additionally has an inner channel extending at least partially through from the proximal end to the distal end.

(8) According to yet another aspect, the present invention is a method for inserting an object into a bone tunnel. The method includes the steps of. (i) providing a surgical tamp having a proximal end and a distal end with an elongated shaft extending therebetween, a cylindrical distal tip at the distal end, and an inner channel extending at least partially through the elongated shaft from the proximal end to the distal end; (ii) inserting an object into the inner channel at the proximal end of the surgical tamp; and (iii) advancing the object within the inner channel to the distal tip of the surgical tamp.

(9) These and other aspects of the invention will be apparent from and elucidated with reference to the embodiment(s) described hereinafter.

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## Description

### BRIEF DESCRIPTION OF THE DRAWINGS

(1) One or more aspects of the present invention are particularly pointed out and distinctly claimed

as examples in the claims at the conclusion of the specification. The foregoing and other objects, features, and advantages of the invention are apparent from the following description taken in conjunction with the accompanying drawings in which:

- (2) FIG. 1 is an image of a device impacting a bone dowel;
- (3) FIG. 2 is an image of a bone dowel inserted into a bone tunnel without a guide pin;
- (4) FIG. 3 is a side view schematic representation of a surgical tamp, according to an embodiment;
- (5) FIG. 4 is a side view schematic representation of a surgical tamp, according to an alternative embodiment;
- (6) FIG. 5 is a perspective view schematic representation of a surgical tamp, according to another embodiment;
- (7) FIG. 6 is a top view schematic representation of the surgical tamp in FIG. 5;
- (8) FIG. 7 is a side view schematic representation of the surgical tamp in FIG. 6;
- (9) FIG. 8 is a perspective view schematic representation of a delivery tube, according to an embodiment;
- (10) FIG. 9 is a top view schematic representation of the delivery tube of FIG. 8; and
- (11) FIG. 10 is a side view schematic representation of the delivery tube of FIG. 9.

#### DETAILED DESCRIPTION OF THE INVENTION

(12) Aspects of the present invention and certain features, advantages, and details thereof, are explained more fully below with reference to the non-limiting examples illustrated in the accompanying drawings. Descriptions of well-known structures are omitted so as not to unnecessarily obscure the invention in detail. It should be understood, however, that the detailed description and the specific non-limiting examples, while indicating aspects of the invention, are given by way of illustration only, and are not by way of limitation. Various substitutions, modifications, additions, and/or arrangements, within the spirit and/or scope of the underlying inventive concepts will be apparent to those skilled in the art from this disclosure.

(13) Referring now to the figures, wherein like reference numerals refer to like parts throughout, FIG. 3 shows a side view schematic representation of a surgical tamp **10**, according to an embodiment. The surgical tamp **10** in FIG. 3 comprises a proximal end **12** and a distal end **14**. The proximal end **12** of the surgical tamp **10** has a proximal handle **16**. The handle **16** can be any suitable shape, with or without ergonomic features, for performing surgical procedures, such as driving a bone dowel allograft into a bone tunnel.

(14) Still referring to FIG. 3, the surgical tamp **10** additionally includes an elongated shaft **18** extending distally from the handle **16**. The elongated shaft **18** extends distally to a distal tip **20**. The elongated shaft **18** is composed of a flexible material (e.g., rigid stainless steel or reinforced plastic, as not to buckle when impacted). The elongated shaft **18** is cannulated such that there is an inner channel **22** therein extending from the proximal end **12** (through the handle **16**) to the distal tip **20**. The elongated shaft **18** is flexible (per its composition, as noted above) and cannulated to accommodate various types of guide pins within the inner channel **22**. A flexible guide pin (not shown) or a rigid guide pin (not shown) can be inserted into the inner channel **22** through the proximal end **12** of the surgical tamp **10**, through the handle **16** and the elongated shaft **18**, and out of the distal tip **20**. A flexible guide pin can be used for femoral tunnels, while a rigid guide pin can be used for tibial tunnels (flexible and rigid as used in this sentence should be understood by a person of ordinary skill in the art in conjunction with a review of this disclosure). The distal tip **20** can be rounded for impacting the bone dowel allograft or bone chips into the bone tunnel. In the depicted embodiment, the distal tip **20** is cylindrical and opaque.

(15) Turning now to FIG. 4, there is shown a side view schematic representation of the surgical tamp **10**, according to an alternative embodiment. In the depicted embodiment, the elongated shaft **18** is composed of a rigid material (e.g., stainless steel or similar material, as should be understood by a person of skill in the art in conjunction with a review of this disclosure). The rigid, elongated shaft **18** comprises a slot **24** extending from the distal tip **20** to the handle **16**, as shown in FIG. 4.

The slot **24** in the elongated shaft **18** extends into the inner channel **22** of the elongated shaft **18**. The slot **24** allows a flexible guide pin (not shown) to exit a side **26** (or exterior surface) of the elongated shaft **18**. The ability of the flexible guide pin to exit the side **26** of the shaft **18** allows for axial impaction of the surgical tamp **10** without interference from the guide pin. Due to the slot **24**, the movement of the surgical tamp **10** has the ability to change axes while impacting the bone dowel or bone chips into a bone tunnel, such a femoral tunnel.

(16) As also shown in FIG. **4**, the distal tip **20** of the surgical tamp **10** is transparent. The transparent, distal tip **20** significantly increases visibility and allows the surgeon to see when the dowel is seated at the distal end **14** of the surgical tamp **10**. Specifically, the surgeon can see when the dowel (not shown) is at a distal aperture **28** of the distal tip **20** (wherein the distal aperture **28** is connected to the inner channel **22**).

(17) Referring now to FIGS. **5-7**, there are shown various views schematic representations of a surgical tamp **10**, according to another embodiment. As shown in FIG. **5**, the alternative embodiment of the surgical tamp **10** does not include a handle **16** (as shown in FIGS. **3-4**). Instead, the surgical tamp **10** has a proximal tip **30** (in addition to the distal tip **20**). FIGS. **6** and **7** show that the surgical tamp **10** comprises a cannulated, elongated shaft **18** extending between a distal tip **20** and the proximal tip **30**. The distal tip **20** and proximal tip **30** allow for impacting at one or both ends **12, 14** of the surgical tamp **10**.

(18) As shown in FIG. **7**, the elongated shaft **18** comprises an inner channel **22** extending from the proximal tip **30** to the distal tip **20**. In a preferred embodiment, the proximal and distal tips **30, 20** are transparent so that the surgeon can see the dowel at both the proximal and distal ends **12, 14** in the surgical tamp **10**. The distal tip **20** comprises the distal aperture **28** extending therethrough and connected to the inner channel **22**. The proximal tip **30** also comprises a proximal aperture **32** extending therethrough and connected to the inner channel **22**.

(19) As shown in FIG. **6**, the elongated shaft **18** additionally comprises a pair of slots, a distal slot **24** extending from a central portion **36** of the elongated shaft **18** toward the distal tip **20** and a proximal slot **38** extending from the central portion **36** of the elongated shaft **18** toward the proximal tip **30**. As used herein, the “central portion” can be any portion of the elongated shaft **18** between the distal slot **24** and the proximal slot **38**. The distal slot **24** and the proximal slot **38** both accommodate and allow for a flexible guide pin (not shown). As described above, slots **24, 38** in the elongated shaft **18** allow for the movement of the surgical tamp **10** to change axes while impacting bone dowels and bone chips. Again, the ability of the flexible guide pin to exit the side **26** of the shaft **18** allows for axial impaction of the surgical tamp **10** without interference from the guide pin.

(20) Turning now to FIGS. **8-10**, there are shown various views schematic representations of a delivery tube **100**, according to an embodiment. The delivery tube **100**, such as that shown in FIG. **8**, is used in conjunction with the surgical tamp **10** (in any embodiments shown in FIGS. **3-7**) for inserting bone dowel allografts (not shown) into the joint or for delivering bone chips (not shown) directly into the bone tunnels. Bone dowel allografts are generally composed of course, cancellous bone. The rough texture of the bone dowels makes it extremely difficult to pass the surrounding soft tissue at the surgical site and into the joint. The delivery tube **100** aids in the insertion of the bone dowel by providing a smooth path into the joint and protecting the surrounding soft tissue. As for bone chips, the delivery tube **100** provides a vessel to carry the chips through the joint, directly into the bone tunnel so that a single bone chip does not fall into an undesired location.

(21) As shown in FIG. **8**, the delivery tube **100** is preferably transparent so that the surgeon can see the bone dowel (not shown) or bone chips (not shown) therein. In an embodiment, the delivery tube **100** is machined from one piece of material. Preferably, the delivery tube **100** is composed of a smooth, hard plastic material (e.g., a thermoplastic polymer such as PETG). FIGS. **9-10** show that the delivery tube **100** comprises an elongated shaft **102** with an open, proximal end **104** and an open, distal end **106**. The elongated shaft **102** has an inner channel **108** extending from the

proximal end **104** to the distal end **106**. In use, a bone dowel or bone chips are within the inner channel **108** of the delivery tube **100** and a surgical tamp **10**, such as that shown in FIGS. 5-7, is inserted into the open, proximal end **104** of the delivery tube **100** to impact the bone dowel or bone chips in the distal direction within the inner channel **108**.

(22) Still referring to FIGS. 9-10, the delivery tube **100** includes an aperture **110** (or window) extending through the delivery tube **100** into the inner channel **108**. In the depicted embodiment, the aperture **110** is near the proximal end **104** of the elongated shaft **102**. The aperture **110** allows for loading additional bone chips (not shown) into the inner channel **108** of the delivery tube **100** without removing the delivery tube **100** from the joint.

(23) In the embodiment of the delivery tube **100** shown in FIGS. 8 and 9, the delivery tube **100** comprises one or more indicators **112** along its exterior surface **114**. The indicators **112** provide a reference for depth. In the depicted embodiment, the indicators **112** are measurements in 10 mm increments, although any suitable system for measuring depth can be used. As the bone chips are inserted into the inner channel **108** of the delivery tube **100** (e.g., through the aperture **110**), a surgeon can gauge how much of the bone tunnel will be filled by bone chips.

(24) All definitions, as defined and used herein, should be understood to control over dictionary definitions, definitions in documents incorporated by reference, and/or ordinary meanings of the defined terms.

(25) While various embodiments have been described and illustrated herein, those of ordinary skill in the art will readily envision a variety of other means and/or structures for performing the function and/or obtaining the results and/or one or more of the advantages described herein, and each of such variations and/or modifications is deemed to be within the scope of the embodiments described herein. More generally, those skilled in the art will readily appreciate that all parameters, dimensions, materials, and configurations described herein are meant to be exemplary and that the actual parameters, dimensions, materials, and/or configurations will depend upon the specific application or applications for which the teachings is/are used. Those skilled in the art will recognize, or be able to ascertain using no more than routine experimentation, many equivalents to the specific embodiments described herein. It is, therefore, to be understood that the foregoing embodiments are presented by way of example only and that, within the scope of the appended claims and equivalents thereto, embodiments may be practiced otherwise than as specifically described and claimed. Embodiments of the present disclosure are directed to each individual feature, system, article, material, kit, and/or method described herein. In addition, any combination of two or more such features, systems, articles, materials, kits, and/or methods, if such features, systems, articles, materials, kits, and/or methods are not mutually inconsistent, is included within the scope of the present disclosure.

(26) The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms “a”, “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprise” (and any form of comprise, such as “comprises” and “comprising”), “have” (and any form of have, such as “has” and “having”), “include” (and any form of include, such as “includes” and “including”), and “contain” (any form of contain, such as “contains” and “containing”) are open-ended linking verbs. As a result, a method or device that “comprises”, “has”, “includes” or “contains” one or more steps or elements. Likewise, a step of method or an element of a device that “comprises”, “has”, “includes” or “contains” one or more features possesses those one or more features, but is not limited to possessing only those one or more features. Furthermore, a device or structure that is configured in a certain way is configured in at least that way, but may also be configured in ways that are not listed.

(27) The corresponding structures, materials, acts and equivalents of all means or step plus function elements in the claims below, if any, are intended to include any structure, material or act for

performing the function in combination with other claimed elements as specifically claimed. The description of the present invention has been presented for purposes of illustration and description, but is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art without departing from the scope and spirit of the invention. The embodiment was chosen and described in order to best explain the principles of one or more aspects of the invention and the practical application, and to enable others of ordinary skill in the art to understand one or more aspects of the present invention for various embodiments with various modifications as are suited to the particular use contemplated.

## Claims

1. A surgical impacting system, comprising: a surgical tamp having a proximal end and a distal end with an elongated shaft including a central portion extending therebetween; a handle positioned at the proximal end and a distal tip positioned at the distal end; an inner channel extending through the elongated shaft from the proximal end to the distal end; a first slot formed through an exterior surface of the elongated shaft and into the inner channel and extending from the distal tip to a position distal to a distal end of the handle; and wherein the first slot is configured and structured to accommodate a guide pin therein.
  2. The system of claim 1, wherein the distal tip is transparent.
  3. The system of claim 1, wherein the distal tip comprises a distal aperture connected to the inner channel.
  4. The system of claim 1, wherein the distal tip is rounded.
  5. The system of claim 1, further comprising a delivery tube having an open, proximal end and an open, distal end with an inner channel extending therebetween, wherein the surgical tamp is movable within the inner channel of the delivery tube.
  6. The system of claim 1, wherein the distal tip is cylindrically shaped.
  7. The system of claim 1, wherein the distal tip comprises a larger diameter than a diameter of the elongated shaft.
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