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Inventor(s)	Gosik-Wolfe; Adam

Implant extractor

Abstract

An implant extractor including a second arm having a proximal end and a distal end, and a first arm having a proximal end for attachment to an extraction device. The first arm additionally has a distal end for attachment to a first jaw, and an adjustment mechanism including an adjuster and a lever. The lever has a proximal end engaged with the adjuster and a distal end pivotably connected to the second arm. The implant extractor additionally includes a link pivotably connected to the first and second arms, the link having a distal end for attachment to a second jaw.

Inventors: **Gosik-Wolfe; Adam (Tampa, FL)**

Applicant: **Shukla Medical** (St. Petersburg, FL)

Family ID: **1000008747426**

Assignee: **Shukla Medical (St. Petersburg, FL)**

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Primary Examiner: Sipp; Amy R

Attorney, Agent or Firm: Kim IP Law Group LLC

Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION (1) This application claims the benefit under 35 U.S.C. § 119(e) to U.S. Provisional Application No. 62/991,940, filed Mar. 19, 2020, and entitled “Glenosphere Extractor,” the entire disclosure of which is hereby incorporated by reference for all purposes.

BACKGROUND OF THE DISCLOSURE
(1) The exemplary embodiments of present invention relate generally to a surgical extraction tool and, more specifically, to a tool for extracting an implant from bone including, without limitation, a glenosphere implant.
(2) Implant extractor tools, including those used to extract a glenosphere from bone, are typically either simple mechanical devices that do not effectively grip the implant or complex mechanical

devices that may effectively grip the implant but are expensive to manufacture and difficult to operate.

BRIEF SUMMARY OF THE DISCLOSURE

(3) In accordance with an exemplary embodiment there is provided an implant extractor comprising a second arm having a proximal end and a distal end, and a first arm having a proximal end for attachment to an extraction device. The first arm additionally has a distal end for attachment to a first jaw, and an adjustment mechanism including an adjuster and a lever. The lever has a proximal end engaged with the adjuster and a distal end pivotably connected to the second arm. The implant extractor additionally comprises a link pivotably connected to the first and second arms, the link having a distal end for attachment to a second jaw.

(4) According to an aspect, the implant extractor further comprises a biasing member biasing the link and the first arm. According to another aspect, the adjuster comprises a rotatable knob, and a rod extending from the rotatable knob and movable relative to the rotatable knob. According to another aspect, the rod is a threaded rod threadedly engaged with the first arm. According to another aspect, the rod includes at least one planar side. According to another aspect, the rotatable knob has an opening with a planar side to cooperate with the planar side of the rod. According to another aspect, the rod abuts the proximal end of the lever. According to another aspect, the first arm includes a cage having an opening for housing the rotatable knob. According to another aspect, the first arm includes a slot to house the rod. According to another aspect, the first arm includes a quick connect about its proximal end.

(5) According to another aspect, the implant extractor further comprises a first jaw releasably attachable to the distal end of the first arm and a second jaw releasably attachable to the distal end of the link. According to another aspect, the first and second jaws each include a slidable lock to slidingly engage a corresponding slidable lock on the first arm and link, respectively. According to another aspect, the corresponding slidable lock on the first arm and link each includes a stop. According to another aspect, the stop on the first arm is a laterally extending stop and the stop of the link is a laterally extending stop. According to another aspect, the slidable lock is a dovetail. According to another aspect, the slidable lock on each of the first and second jaws is a male dovetail and the corresponding slidable lock on each of the first arm and the link is a female dovetail.

(6) According to another aspect, the implant extractor further comprises a detent carried by one of the first jaw and the first arm, or a detent carried by one of the second jaw and the link. According to another aspect, the implant extractor further comprises a locking mechanism on the link movable between a locked position and an unlocked position, wherein in the locked position the locking mechanism maintains clamping engagement of the first and second jaws, and in the unlocked position the locking mechanism permits release of the first and second jaws from clamping engagement with an implant to be extracted. According to another aspect, the implant extractor further comprises a release lever on the second arm to release of the first and second jaws from clamping engagement with an implant to be extracted.

(7) Other features and advantages of the subject disclosure will be apparent from the following more detailed description of the exemplary embodiments.

Description

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

(1) The foregoing summary, as well as the following detailed description of the exemplary embodiments of the subject disclosure, will be better understood when read in conjunction with the appended drawings. For the purpose of illustrating the present disclosure, there are shown in the drawings exemplary embodiments. It should be understood, however, that the subject application is

not limited to the precise arrangements and instrumentalities shown.
(2) FIG. **1** is side view of an implant extractor in accordance with an exemplary embodiment of the subject disclosure;
(3) FIG. **2** is a posterior side view of the implant extractor of FIG. **1**;
(4) FIG. **3** is an exploded side view of the implant extractor of FIG. **1** with certain elements shown in phantom line for purposes of clarity;
(5) FIG. **4**A is an exploded perspective view of an extraction device, strike plate and quick connect of the implant extractor of FIG. **1**;
(6) FIG. **4**B is a plan view of a strike plate of the implant extractor of FIG. **1**;
(7) FIG. **5** is a partial cross-sectional side view of the implant extractor of FIG. **1**;
(8) FIG. **6** is a rear perspective view of the implant extractor of FIG. **1** with a rotatable knob shown separated from the implant extractor;
(9) FIG. **7**A is side view of a second arm of the implant extractor of FIG. **1**;
(10) FIG. **7**B is a perspective view of the second arm of FIG. **7**A;
(11) FIG. **8**A is a rear perspective view of a first arm of the implant extractor of FIG. **1**;
(12) FIG. **8**B is a front perspective view of the first arm of FIG. **8**A;
(13) FIG. **8**C is a bottom view of the first arm of FIG. **8**A;
(14) FIG. **8**D is a cross-sectional side view of the first arm of FIG. **8**A;
(15) FIG. **8**E is a phantom line side view of the first arm of FIG. **8**A including a threaded rod threadedly engaging the first arm;
(16) FIG. **9**A is a perspective view of a threaded rod of an adjuster of the implant extractor of FIG. **1**;
(17) FIG. **9**B is an end view of the threaded rod of FIG. **9**A;
(18) FIG. **10**A is a side view of a rotatable knob of an adjuster of the implant extractor of FIG. **1**;
(19) FIG. **10**B is an end view of the rotatable knob of FIG. **10**A;
(20) FIG. **11** is a left perspective view of a lever of the implant extractor of FIG. **1**;
(21) FIG. **12**A is a side view of a link of the implant extractor of FIG. **1**;
(22) FIG. **12**B is a front perspective view of the link of FIG. **12**A;
(23) FIG. **12**C is a rear perspective view of the link of FIG. **12**A;
(24) FIG. **13** is a rear perspective of the implant extractor of FIG. **1** with first and second jaws thereof omitted for purposes of clarity;
(25) FIG. **14** is a rear perspective view of a first jaw of the implant extractor of FIG. **1**;
(26) FIG. **15** is a rear perspective view of a second jaw of the implant extractor of FIG. **1**;
(27) FIG. **16** is a perspective view of the lever, the second arm and the locking mechanism of the implant extractor of FIG. **1** in an unlocked position;
(28) FIG. **17** is a top view of the lever, the second arm and the locking mechanism of FIG. **16** in an unlocked position;
(29) FIG. **18** is a top view of the lever, the second arm and the locking mechanism of FIG. **16** in a locked position;
(30) FIG. **19** is a perspective view of a release lever and the second arm of the implant extractor of FIG. **1** with the second arm shown in phantom line for purposes of clarity;
(31) FIG. **20**A is a side view of an alternative configuration of the first jaw of the implant extractor of FIG. **1**;
(32) FIG. **20**B is a perspective view of the alternative configuration of the first jaw of FIG. **20**A;
(33) FIG. **20**C is a perspective view of the alternative configuration of the first jaw of FIG. **20**A;
(34) FIG. **21**A is a side view of an alternative configuration of the second jaw of the implant extractor of FIG. **1**;
(35) FIG. **21**B is a perspective view of the alternative configuration of the second jaw of FIG. **21**A;
(36) FIG. **21**C is a perspective view of the alternative configuration of the second jaw of FIG. **21**A;
(37) FIG. **22**A is a bottom perspective view of an another exemplary embodiment of an of the

implant extractor in accordance with the subject disclosure;
(38) FIG. **22**B is a top perspective view of the implant extractor of FIG. **22**A;
(39) FIG. **22**C is an side view of the implant extractor of FIG. **22**A;
(40) FIG. **23** is an elevation view of a connector configured for use in the implant extractor of FIGS. **22**A-**22**C;
(41) FIG. **24**A is a perspective view of yet another exemplary embodiment of an implant extractor in accordance with the subject disclosure;
(42) FIG. **24**B is side view of the implant extractor of FIG. **24**A;
(43) FIG. **25**A is a top perspective view of an extraction device of the implant extractor of FIGS. **24**A and **24**B; and
(44) FIG. **25**B is a side view of the extraction device of FIG. **25**A.

DETAILED DESCRIPTION OF THE DISCLOSURE

(45) Reference will now be made in detail to the various exemplary embodiments of the subject disclosure illustrated in the accompanying drawings. Wherever possible, the same or like reference numbers will be used throughout the drawings to refer to the same or like features. It should be noted that the drawings are in simplified form and are not drawn to precise scale. Certain terminology is used in the following description for convenience only and is not limiting. Directional terms such as top, bottom, left, right, above, below and diagonal, are used with respect to the accompanying drawings. The term “distal” shall mean away from the center of a body. The term “proximal” shall mean closer towards the center of a body and/or away from the “distal” end. The words “inwardly” and “outwardly” refer to directions toward and away from, respectively, the geometric center of the identified element and designated parts thereof. Such directional terms used in conjunction with the following description of the drawings should not be construed to limit the scope of the subject application in any manner not explicitly set forth. Additionally, the term “a,” as used in the specification, means “at least one.” The terminology includes the words above specifically mentioned, derivatives thereof, and words of similar import.
(46) “About” as used herein when referring to a measurable value such as an amount, a temporal duration, and the like, is meant to encompass variations of ±20%, ±10%, ±5%, ±1%, or ±0.1% from the specified value, as such variations are appropriate.
(47) “Substantially” as used herein shall mean considerable in extent, largely but not wholly that which is specified, or an appropriate variation therefrom as is acceptable within the field of art. “Exemplary” as used herein shall mean serving as an example.
(48) Throughout the subject application, various aspects thereof can be presented in a range format. It should be understood that the description in range format is merely for convenience and brevity and should not be construed as an inflexible limitation on the scope of the subject disclosure. Accordingly, the description of a range should be considered to have specifically disclosed all the possible subranges as well as individual numerical values within that range. For example, description of a range such as from 1 to 6 should be considered to have specifically disclosed subranges such as from 1 to 3, from 1 to 4, from 1 to 5, from 2 to 4, from 2 to 6, from 3 to 6 etc., as well as individual numbers within that range, for example, 1, 2, 2.7, 3, 4, 5, 5.3, and 6. This applies regardless of the breadth of the range.
(49) Furthermore, the described features, advantages and characteristics of the exemplary embodiments of the subject disclosure may be combined in any suitable manner in one or more embodiments. One skilled in the relevant art will recognize, in light of the description herein, that the subject disclosure can be practiced without one or more of the specific features or advantages of a particular exemplary embodiment. In other instances, additional features and advantages may be recognized in certain embodiments that may not be present in all exemplary embodiments of the present disclosure.
(50) Referring now to the drawings, FIGS. **1**-**3**, **5** and **6** illustrate an implant extractor **100** in accordance with an exemplary embodiment of the present disclosure. The implant extractor **100**

includes a second arm **102** having a proximal end **104** and a distal end **106**, and a first arm **108** having a proximal end **110** for attachment to an extraction device **112**. The extraction device **112** can be any suitable extraction device including, without limitation, a T-handle. The first arm additionally has a distal end **114** for attachment to a first jaw **116**, and an adjustment mechanism **118** including an adjuster **120** and a lever **122**. The lever has a proximal end **124** engaged with the adjuster and a distal end **126** pivotably connected to the second arm **102** via pivot pin **128**. The implant extractor **100** additionally comprises a link **130** pivotably connected to the first and second arms via pivot pins **132**, **134**, the link having a distal end **136** for attachment to a second jaw **138**.
(51) FIGS. **4**A and **4**B illustrate that the implant extractor can optionally include a planar laterally projecting strike plate **140** located adjacent the proximal end of the first arm. The strike plate includes a proximal face **140***a* and a distal face **140***b* and can include an opening e.g., a polygonal opening **139** for receiving a correspondingly shaped base e.g., polygonal base **141** of a quick connect **198**, discussed below. So constructed, the strike plate may be rotatably positioned at different angles, and more specifically at different rotated angles about a longitudinal axis of the implant extractor or the implant extractor itself and set at an angle that is most appropriate and comfortable to the user for extraction. By way of example, the polygonal opening in the strike plate and the polygonal base **141** of the quick connect can be octagonal, whereby the strike plate may be placed in any one of eight positions about the implant extractor, or alternatively a polygonal base with a square, pentagon, hexagon, heptagon, nonagon, decagon, dodecagon shape or any number of sides corresponding in number to a plurality of sides of the polygonal opening. The extraction device **112** holds the strike plate **140** in place and both are easily removable from the quick connect **198**.
(52) The second arm **102** is configured as best shown in FIGS. **1**, **7**A and **7**B, and is constructed as an elongated arm having a channel formed by upstanding sidewalls **150**, **152**. About its midportion the second arm is provided with a pair of notches **146**, **148** in the upstanding side walls **150**, **152** which are adapted to cooperate with a locking mechanism **154** (described below in connection with FIGS. **16** and **17**) carried by the lever **122**. The side walls **150**, **152** further include a first pair of aligned openings **156**, **158** that receive the pivot pin **128** for pivotably connecting the distal end **126** of the lever **122** to the second arm. About the distal end **106** of the second arm is a through bore **160** that aligns with aligned openings **162**, **164** provided in the lower branches **166**, **168** of the link **130** (FIGS. **12**A-**12**C) to receive the pivot pin **134** to pivotably connect the distal end of the second arm **102** to the lower branches of the link. Additionally, the side walls **150**, **152** include a second pair of aligned openings **170**, **172** that receive a pivot pin **174** (FIGS. **1**, **3**, and **5**) that likewise passes through a through bore **176** provided at a distal end **178** of a release lever **180** (FIG. **19**) for pivotably connecting the distal end of the release lever to the second arm. The function of the release lever **180** is described in greater detail in connection with FIG. **19**.
(53) The construction of the first arm **108** is configured as best shown in FIGS. **1**, **3**, **5** and **8**A-**8**E. FIGS. **8**A-**8**E show a first arm body **109** of the first arm. Adjacent the distal end **114** of the first arm body there is provided a through bore **182** that aligns with aligned openings **184**, **186** provided in the upper branches **188**, **190** of the link **130** (FIGS. **12**A-**12**C) to receive the pivot pin **132** to pivotably connect the distal end of the first arm **108** to the upper branches of the link. Also adjacent the distal end of the first arm body is a transverse opening **300** which includes fastener structure **302** configured to releasably retain various forms of extraction devices which are described in greater detail hereinafter. Near the proximal end **110**, the first arm body includes a cage **192** having an opening or hollow interior **194** for housing a rotatable knob **196** which forms part of the adjuster **120** of the adjustment mechanism **118** (see also FIGS. **1**, **3**, **5** and **10**A). Adjacent a distal end of the cage **192** is an internally threaded through bore **200** (FIGS. **8**B, **8**D and **8**E). The through bore **200** is in fluid communication with the cage **192** and with a slot **202** (FIGS. **8**C-**8**F) structured to house a rod **216**, as further discussed below. Adjacent the slot **202** the first arm body includes a pair of side walls **204**, **206** that is provided with aligned openings **208**, **210** (FIGS. **8**B and **8**C) to receive a

pin **212** which holds a first end of a biasing member **144** (FIGS. **1**, **3**, and **5**). As shown in FIG. **8**A, at the tip of the distal end **114**, the first arm includes a slidable lock **214** for attachment to the first jaw **116**, which is discussed in further detail below.

(54) The first arm also includes the quick connect **198** (FIG. **3**) about its proximal end structured to releasably engage with, e.g., a corresponding female quick connection carried by the extraction device **112**. The corresponding female quick connection includes a biased locking member **199**.

(55) FIGS. **3** and **5** best illustrate the adjustment mechanism **118** of the first arm **108**. The adjustment mechanism includes the adjuster **120** and the lever **122**. The adjuster comprises the rotatable knob **196** and the rod **216**. The rod **216** extends from the rotatable knob and is movable relative to the rotatable knob. The rod **216** is a threaded rod (FIGS. **8**E, **9**A and **9**B) threadedly engaged with the first arm at the internally threaded through bore **200** as shown in FIG. **8**E. The rod **216** includes at least one planar side **218**, and preferably a pair of opposing planar sides **218**A, **218**B. The rod also includes a non-threaded distal nose **219**. The rod is sized in length sufficiently such that the distal nose **219** of the rod **216** abuts the proximal end **124** of the lever **122**.

(56) The rotatable knob **196** is configured as best shown in FIGS. **10**A and **10**B having a generally cylindrical configuration. The outer surface of the rotatable knob is preferably textured, e.g. with splines, knurling or the like, to enhance gripping of a user's fingers when rotating the rotatable knob. As shown in FIG. **10**B, the rotatable knob **196** has an opening **220** about its end or proximally facing end, with a planar side **222** to cooperate with the planar side **218** of the rod **216**. Rotation of the rotatable knob **196** causes rotation of the threaded rod **216** within the internally threaded through bore **200**, thereby causing the rod **216** to extend from or retract into the rotatable knob depending on the direction of rotation of the rotatable knob, or in other words move along a direction of a longitudinal axis of the rod. More particularly, rotation of the rotatable knob **196** in a first direction causes the rod **216** to extend from the rotatable knob. In so doing, the distal nose **219** of the rod pushes further against the proximal end **124** of the lever **122**. Conversely, rotation of the rotatable knob **196** in a second direction causes the rod **216** to retract into the rotatable knob. In so doing, the proximal end **124** of the lever **122** remains in contact with the distal nose **219** of the rod **216** since it is under the influence of the biasing member **144**, discussed below.

(57) The lever **122** is structured as best shown in FIGS. **1**, **5** and **11**. Referring to FIG. **11**, between its proximal and distal ends **124**, **126**, the lever **122** includes a first through bore **226** that receives the pivot pin **128** for pivotably connecting the distal end **126** of the lever **122** to the second arm (FIGS. **3**, **5** and **6**). The lever **122** further includes a second through bore **228** through which the locking mechanism **154** passes (see FIGS. **1-3**, **6** and **16**).

(58) FIGS. **12**A-**12**C best show the construction of the link **130**. The link includes upper and lower branches. Between the upper branches **188**, **190** and lower branches **166**, **186**, the link includes a pair of aligned through bores **230**, **232**. The through bores **230**, **232** receive a pin **234** which holds a second end of the biasing member **144** (FIGS. **1**, **3**, and **5**). The distal end **136** of the link **130** is provided with a fastener **256** for attaching the second jaw **138** to the link. Likewise, the distal end **114** of the first arm **108** is provided with a fastener **254** for attaching the first jaw **116** to the first arm. As shown in FIG. **12**B the link includes an aperture **259** for receiving a mail dovetail **252** of the second jaw **138**. As a result the first jaw is releasably attachable to the distal end of the first arm via engagement of a male dovetail **250** of the first jaw with an aperture **257** of the first arm and the second jaw is releasably attachable to the distal end of the link via engagement of the male dovetail **252** with the link aperture **259**.

(59) The fasteners at the distal ends of the link and the first arm are preferably cooperating fasteners or slidable locks that respectively engage cooperating fasteners or cooperating slidable locks provided at the proximal ends of the first and second jaws.

(60) The implant extractor **100** further comprises the aforementioned biasing member **144** which is connected to and biases the link **130** and the first arm **108**, in a manner described in greater detail below. The biasing member can be e.g., a tension spring, an elastomer or the like. In the present

embodiment, the tension spring has a spring constant of about 0.5 to 8.0 lbs, including 0.4, 0.6, 0.7, 0.8, 0.9, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, and 9.0 lbs.

(61) The first and second jaws respectively are structured as best shown in FIGS. **14** and **15**. The first and second jaws respectively include a corresponding recess **260** and **264** to releasably engage respective corresponding detents **258**, **262** (FIG. **13**) on the distal ends of the first arm and the link. The first and second jaws respectively include slidable locks **236** and **238** to slidingly engage a corresponding slidable lock **214**, **240** on the first arm **108** and link **130**, respectively, as shown in FIG. **13**. Still referring to FIG. **13**, the corresponding slidable locks on the first arm and link each includes a stop **242**, **244**. According to an aspect, the stops **242**, **244** are distally extending ledges. The stops **242**, **244** are engageable by flats **246**, **248** respectively provided on the first and second jaws (FIGS. **14** and **15**) to limit insertion of the first and second jaws into the first arm and the link.

(62) According to another aspect, the slidable lock **236** and **238** on each of the first and second jaws is the male dovetail **250** and **252**, respectively (FIGS. **14** and **15**), and the corresponding slidable lock **214**, **240** on each of the first arm and the link is a female dovetail **254** and **256**, respectively (FIG. **13**). The first and second jaws are thus inserted from inner or medial sides of the first arm and the link towards their outer or lateral sides thereof, whereby the flats **246**, **248** stop the slidable locks from further insertion upon engagement with the stops **242**, **244**. Additionally, the male dovetails **250**, **252** of the jaws have longitudinal lengths whereby, when inserted into the female dovetails **254**, **256**, the male dovetails project outwardly of the first arm and the link, as shown in FIGS. **1** and **3**.

(63) According to another aspect, the implant extractor further comprises a detent **258** (FIG. **13**) carried by one of the first jaw and the first arm, or a detent **262** carried by the one of the second jaw and the link. In the illustrated exemplary embodiment, the detent **258** is carried by the first arm for engaging a corresponding recess **260** in the first jaw, and the detent **262** is carried by the link for engaging corresponding recess **264** in the second jaw (FIGS. **13-15**). An exemplary detent can be e.g., a ball detent. As shown in FIG. **5**, the detents **258**, **262** are urged outwardly toward engagement with recesses **260**, **264** by biasing members **266** and **268**, such as springs or the like. Engagement of the detents with their corresponding recesses operates to resist inadvertent dislodgement of the first and second jaws from the first arm and the link. When it is desired to release the jaws from the first arm and the link, the user presses against the outwardly projecting male dovetails **250**, **252** with sufficient force to overcome the biasing force of the biasing members **266**, **268**, whereby the detents become dislodged from the recesses.

(64) The locking mechanism **154** is configured as best shown in FIGS. **16-18**. The locking mechanism **154** is carried by the lever **122**. That is, the locking mechanism is on the lever and movable between a locked position and an unlocked position. In the locked position (FIG. **18**), the locking mechanism maintains clamping engagement of the first and second jaws and, in the unlocked position (FIGS. **16** and **17**), the locking mechanism permits release of the first and second jaws from clamping engagement with an implant to be extracted.

(65) The locking mechanism includes a central shaft **270** sized to reciprocate within the through bore **228** of the lever **122**. At opposite ends of the central shaft **270**, the locking mechanism includes first cylindrical portions **272**, **274** of larger diameter than the central shaft that are sized to be received in notches **146**, **148** provided in the upstanding side walls of the second arm **102**. Additionally, adjacent the outside or lateral ends of the first cylindrical portions are second cylindrical portions or buttons **276**, **278** of larger diameter than the first cylindrical portions. The outer surfaces **280**, **282** of the buttons **276**, **278** are adapted to be pressed by a user's finger.

(66) To place the locking mechanism **154** into the locked position, the user presses the outer surface **280** of the button **276** until the first cylindrical portion **272** is received in notch **148** (FIG. **18**). The notch **148** includes an overhang **284** which overlies the first cylindrical portion **272**. The overhang prevents dislodgement of the cylindrical portion **272** from the notch **148** and secures the second arm **102** and the lever **122** connected thereto into a locked position.

(67) To place the locking mechanism **154** into the unlocked position, i.e., to release the locking mechanism from the locked position, a user presses the outer surface **282** of the button **278** until the first cylindrical portion **272** is no longer received in the notch **148** and retained by the overhang **284**. With the locking mechanism **154** in such position, the user can separate the second arm from the first arm whereby the first and second jaws are released from clamping engagement with implant **142**.

(68) The implant extractor **100** further comprises a release lever **180** (FIG. **19**) on the second arm **102** to release the first and second jaws from clamping engagement with an implant to be extracted. The release lever has a knuckle **286** provided adjacent the distal end **178** thereof, and a proximal end **288** projecting from the proximal end **104** of the second arm. Before deploying the release lever, the user must place the locking mechanism **154** oriented in the unlocked position. The proximal end **288** of the release lever is lifted upwardly (as shown in FIG. **19**) until the knuckle **286** contacts the underside of the lever **122**. Further lifting of the release lever operates to withdraw the locking mechanism from the notches **146**, **148** and push the second arm **102** away from the first arm **108**, thereby allowing the first and second jaws to spread apart.

(69) The first and second jaws **116**, **138** heretofore discussed can be referred to as straight jaws in that the proximal ends of the jaws extend straight from the distal ends of the first arm and the link. FIGS. **20**A-**20**C and **21**A-**21**C illustrate an alternative exemplary configuration of the first and second jaws. The first and second jaws **116**A, **138**A illustrated can be referred to as laterally offset jaws. In this regard, intermediate regions of the first and second jaws **116**A, **138**A include laterally directed bend **290** and **290′**, respectively, whereby the distal ends of the jaws are laterally offset from the distal ends of the first arm and the link.

(70) The first and second jaws **116**, **138** (or **116**A, **138**A) are operable to releasably clamp a medical implant including, without limitation, e.g., a glenosphere implant **142**.

(71) Referring to the first and second jaws **116**, **138** as an example, in order to clamp the first and second jaws onto an implant to be extracted, a user first rotates the rotatable knob **196** in a first direction which causes the first and second jaws to separate until opposed lips **292**, **294** at respective distal ends of the first and second jaws (FIGS. **14** and **15**) are spaced slightly wider than the circumference of the implant to be extracted. More particularly, rotation of the rotatable knob in the first direction causes the distal end **126** of the lever and the second arm **102** to move rearwardly, whereby the link **130** pivots rearwardly and the second jaw **138** moves away from the first jaw **116**. The user then places the opposed lips adjacent the implant and rotates the rotatable knob in the opposite direction which causes the first and second jaws to close around the implant until the lips **292**, **294** are positioned behind the implant. More particularly, rotation of the rotatable knob in the opposite direction causes the distal end **126** of the lever and the second arm **102** to move forwardly, whereby the link **130** pivots forwardly causing the second jaw **138** to move toward the first jaw **116**. Additionally, the biasing member **144** keeps the first and second jaws open during clamping of the implant **142**. That is, the biasing member serves to prevent the second jaw from uncontrolled movement which could hinder clamping of the first and second jaws to the implant. The user then squeezes the first and second arms together whereupon the second arm pivots posteriorly until the locking mechanism **154** becomes seated in the notches **146**, **148** of the second arm. During seating of the locking mechanism into the notches, the first and second jaws are urged into tight clamping engagement with the implant **142**. Once the locking mechanism is fully seated in the notches, the user presses the outer surface **280** of the button **276** until the first cylindrical portion **272** is received in the notch **148**, thereby locking the position of the second arm relative to the first arm. With the second arm locked and the implant extractor **100** secured to the implant, the user may use the implant extractor to pull the implant from the bone to which it is attached. If additional force is necessary to extract the implant, the user may strike the distal face **140***b* of the strike plate **140** with a hammer, mallet or similar striking tool to dislodge the implant. Once the implant is freed, the user unlocks the locking mechanism **154** and lifts the proximal end **284** of the release lever to open the

first and second jaws and release the implant from the implant extractor.

(72) FIGS. **22**A-**22**C show another exemplary embodiment of an implant extractor **100**′ according to the subject disclosure. In many respects, the implant extractor **100**′ is similar in construction to the implant extractor **100**. Accordingly, for brevity only those aspects of the implant extractor **100**′ which materially depart in structure and/or function from the implant extractor **100** will be described in detail. In this regard, the implant extractor **100**′ comprises a connector member **310** (FIG. **23**) constructed and arranged to releasably join an extraction device **312** to the fastener structure of the transverse opening **300** in the first arm **108**. In the illustrated example of FIGS. **22**A-**22**C, the extraction device extends from the first arm in a lateral direction opposite the distal ends of the jaws, e.g., laterally extending jaws. According to an aspect, the extraction device **312** comprises a T-handle **112**′ and a strike plate **140**′ (including an upper face **140***a*′ and a lower face **140***b*′) which are releasably connectable to the connector member **310** similar to the manner in which the T-handle and the strike plate are joined to the proximal end of the implant extractor **100**, as described above.

(73) Referring to FIG. **23**, the connector member **310** includes a fastener **314** in the form of external threading at a first end thereof for engaging the corresponding fastener in the form of internal threading **302** of the transverse opening **300**. While illustrated as being cooperating threading, the fastener of the connector member and the transverse opening may assume other forms including, without limitation, a J-slot connection, press-fit, Luer lock, slip-fit with ball detent, and the like. Adjacent threading **314**, the connector member further includes a radially projecting turning knob **316**, the exterior of which is desirably provided with grip-enhancing structure such as knurling or, as illustrated, ribs to facilitate threading of the connector member into the transverse opening in the first arm. On the side of knob **316** opposite fastener structure **314** is a polygonal base **141**′ for receiving an unillustrated correspondingly shaped opening in the strike plate **140**′. The connector member further includes a quick connect **198**′ that is structured to releasably engage with a corresponding quick connector, e.g., a biased locking member **199**′ (FIG. **22**B) carried by the extraction device **312**. The T-handle **112**′ holds the strike plate **140**′ in place and both are easily removable from the quick connect **198**′ upon depression of the biased locking member **199**′.

(74) When the extraction device **312** is secured to the implant extractor **100**′ and the implant extractor is clamped on an implant in the manner described above, a user may strike the lower face **140***b*′ of the strike plate **140**′ with a hammer, mallet or the like, in order to dislodge the implant from bone.

(75) Referring to FIGS. **24**A and **24**B, there is shown another exemplary embodiment of an implant extractor **100**″ according to the subject disclosure. Since the implant extractor **100**″ is structurally and functionally similar to implant extractor **100**, only those aspects of the implant extractor **100**″ which materially depart in structure and/or function from the implant extractor **100** will be described in detail. In this regard, the implant extractor **100**″ includes an extraction device **412**. In the illustrated example, the extraction device extends from the first arm in a lateral direction on the same side as the distal ends of the jaws, e.g., laterally extending jaws. As shown in FIGS. **25**A and **25**B, the extraction device includes a fastener **414** in the form of external threading for engaging the corresponding fastener in the form of internal threading **302** of the transverse opening **300** in the first arm **108**. While illustrated as being cooperating threading, the fastener structures of the extraction device and the transverse opening may assume other forms including, without limitation, a J-slot connection, press-fit, Luer lock, slip-fit with ball detent, and the like. Adjacent threading **414**, the extraction device further includes a radially projecting turning knob **416**, the periphery of which is desirably provided with grip-enhancing structure such as a plurality of notches **418** for receiving a user's fingers to facilitate threading of the extraction device **412** into the transverse opening in the first arm. The exposed upper surface **420** defines a striking surface adapted for striking by a hammer, mallet or the like.

(76) When the extraction device **412** is secured to the implant extractor **100**″ and the implant extractor is clamped on an implant in the manner described above, a user may strike the upper surface **420** of the extraction device with a hammer, mallet or the like, in order to dislodge the implant from bone.
(77) It will be appreciated by those skilled in the art that changes could be made to the exemplary embodiments described above without departing from the broad inventive concept thereof. It is to be understood, therefore, that this disclosure is not limited to the particular embodiments disclosed, but it is intended to cover modifications within the spirit and scope of the subject disclosure as defined by the appended claims.

Claims

1. An implant extractor comprising: a second arm having a proximal end and a distal end; a first arm having: a proximal end, a distal end attached to a first jaw, and an adjustment mechanism about the distal end that includes: an adjuster having: a rotatable knob, and a rod housed completely within the first arm and extending into the rotatable knob and movable relative to the rotatable knob; a lever movable relative to the first arm, the lever having a proximal end engaged with the adjuster and a distal end pivotably connected to the second arm; and a link pivotably connected to the first and second arms, the link having a distal end attached to a second jaw.
2. The implant extractor of claim 1, further comprising a biasing member biasing the link and the first arm.
3. The implant extractor of claim 1, wherein the rod is a threaded rod threadedly engaged with the first arm.
4. The implant extractor of claim 1, wherein the rod includes at least one planar side.
5. The implant extractor of claim 4, wherein the rotatable knob has an opening with a planar side to cooperate with the planar side of the rod.
6. The implant extractor of claim 1, wherein the rod abuts a most proximal end of the lever.
7. The implant extractor of claim 1, wherein the first arm includes a cage having an opening for housing the rotatable knob.
8. The implant extractor of claim 1, wherein the first arm includes a quick connect about its proximal end.
9. The implant extractor of claim 1, further comprising a first jaw releasably attachable to the distal end of the first arm and a second jaw releasably attachable to the distal end of the link.
10. The implant extractor of claim 9, wherein the first and second jaws each include a slidable lock to slidingly engage a corresponding slidable lock on the first arm and link, respectively.
11. The implant extractor of claim 10, wherein the corresponding slidable lock on the first arm and link each includes a stop.
12. The implant extractor of claim 10, wherein the slidable lock is a dovetail.
13. The implant extractor of claim 10, wherein the slidable lock on each of the first and second jaws is a male dovetail and the corresponding slidable lock on each of the first arm and the link is a female dovetail.
14. The implant extractor of claim 10, further comprising a detent carried by one of the first jaw and the first arm or a detent carried by one of the second jaw and the link.
15. The implant extractor of claim 1, further comprising a locking cylinder on the lever movable between a locked position and an unlocked position, wherein in the locked position the locking cylinder maintains clamping engagement of the first and second jaws, and in the unlocked position the locking cylinder permits release of the first and second jaws from clamping engagement with an implant to be extracted.
16. The implant extractor of claim 10, further comprising a release lever on the second arm to release the first and second jaws from clamping engagement with an implant to be extracted.

17. The implant extractor of claim 1, wherein the first arm includes a transverse opening having fastener structure configured to releasably retain an extraction device.

18. An implant extractor comprising: a second arm having a proximal end and a distal end; a first arm having: a proximal end for attachment to an extraction device, a distal end for attachment to a first jaw, and an adjustment mechanism that includes: an adjuster having: a rotatable knob, and a rod entirely within the first arm and extending into the rotatable knob and movable relative to the rotatable knob, and a cage having an opening for housing the rotatable knob; a lever movable relative to first arm, the lever having a proximal end engaged with the adjuster and a distal end pivotably connected to the second arm; and a link pivotably connected to the first and second arms, the link having a distal end for attachment to a second jaw.

19. An implant extractor comprising: a second arm having a proximal end and a distal end; a first arm having: a proximal end for attachment to an extraction device, a distal end for attachment to a first jaw, and an adjustment mechanism that includes: an adjuster having: a rotatable knob, and a rod entirely within the first arm and extending into the rotatable knob and movable relative to the rotatable knob; a lever movable relative to first arm, the lever having a proximal end engaged with the adjuster and a distal end pivotably connected to the second arm; a locking cylinder on the lever movable between a locked position and an unlocked position, the locking cylinder including a first cylindrical portion and a second cylindrical portion smaller than the first cylindrical portion; and a link pivotably connected to the first and second arms, the link having a distal end for attachment to a second jaw.