



Orthopedic Drill Stop Device

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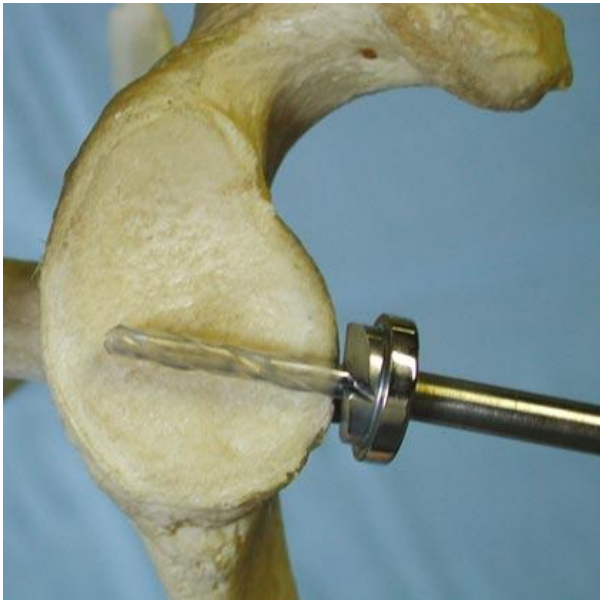
- Motivation and Background
- Client Requirements
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- Electronic Design
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- Mechanical Sleeve Mechanisms
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Motivation and Background

- Dr. O' Connor is a resident in Orthopedic Surgery at the UW-Hospital.
- He is concerned about over-penetration when drilling, leading to soft-tissue damage
- Current method: pre-determined drill depth



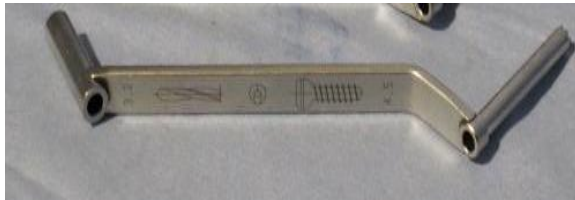
http://img.diytrade.com/cdimg/125566/8070293/0/1235444712/Wire_and_Pin_Drill.jpg



- Minimize plunge depth after penetrating far side of the bone.
- Intuitive design for ease of use
- Easy to sterilize
- Precise device so no soft tissue is damaged

Current Device

- Used as a drill guide
- No stop mechanism



<http://www.hhsurgical.com/Images/Products/1557.jpg>

Spinal Drill Guide

- Pre-adjustable depth
- Not able to change depth while bit is engaged



<http://www.medscape.com>

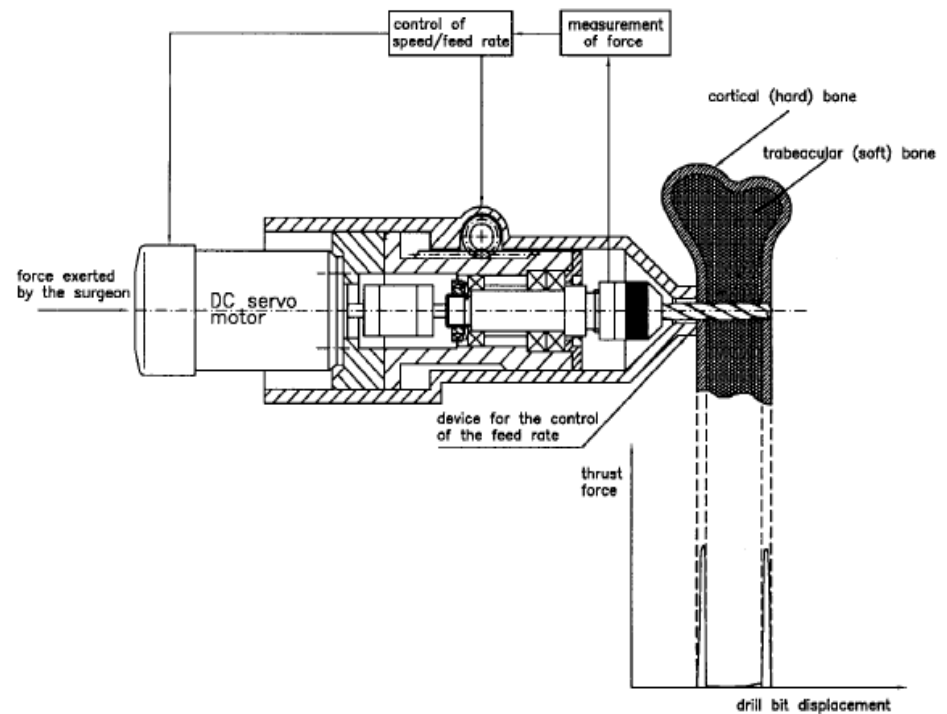


Neurosurgery Drill Bit

- ACRA-CUT Smart Drill
- Has an outer and inner drill
- Pressure on the inner drill allows the outer drill to spin
- Prevents over-penetration

urocirugia.com/instrumental/index.php?m=01&y=08&entry=entry080116-124850

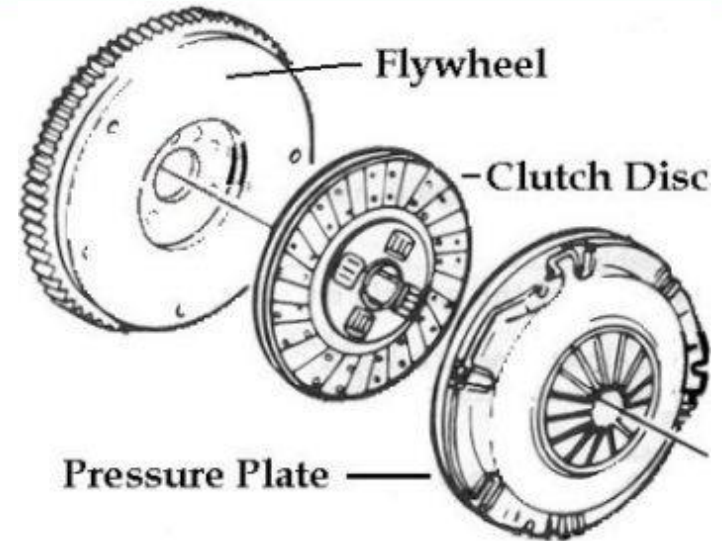
- Measures force on drill bit
- Drill speed/feed rate is controlled based on force feedback
- Prevents excess penetration through bone without requiring user's reflexes



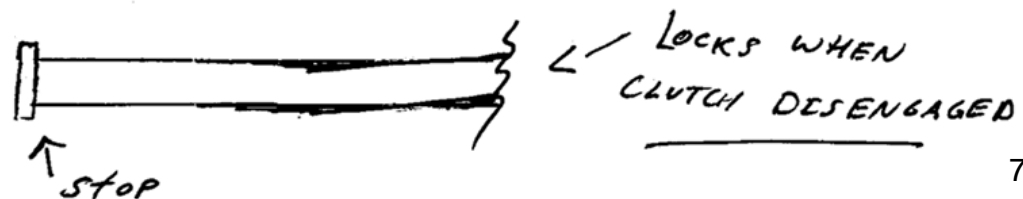
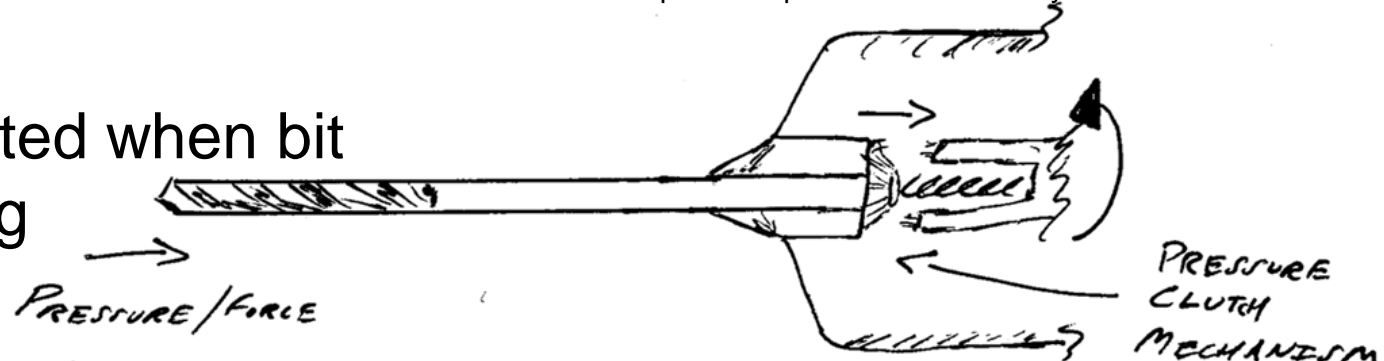
Allotta, Benedetto. (1997) A Hand-Held Drilling Tool for Orthopedic Surgery. *IEEE/ASME Transactions on Mechatronics*. 2 (4), 218-229.

Pressure Clutch Mechanism

- Pressure/Force on drill bit activates clutch and spins bit
- Once the bit penetrates the posterior cortex, the bit stops spinning
- Stop is activated when bit stops spinning
- Reduces plunge depth

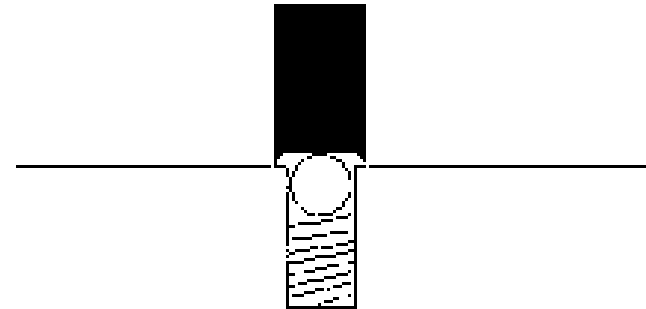


<http://autorepair.about.com/library/a/1i/bl201i.htm>

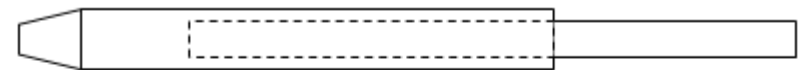


Mechanical Sleeve Mechanisms

- Trigger design
- Thumb wheel design
- Dynamically control the depth of the drill bit while drilling
 - Quicker procedure
 - More accurate drilling
- Detents used for millimeter increments



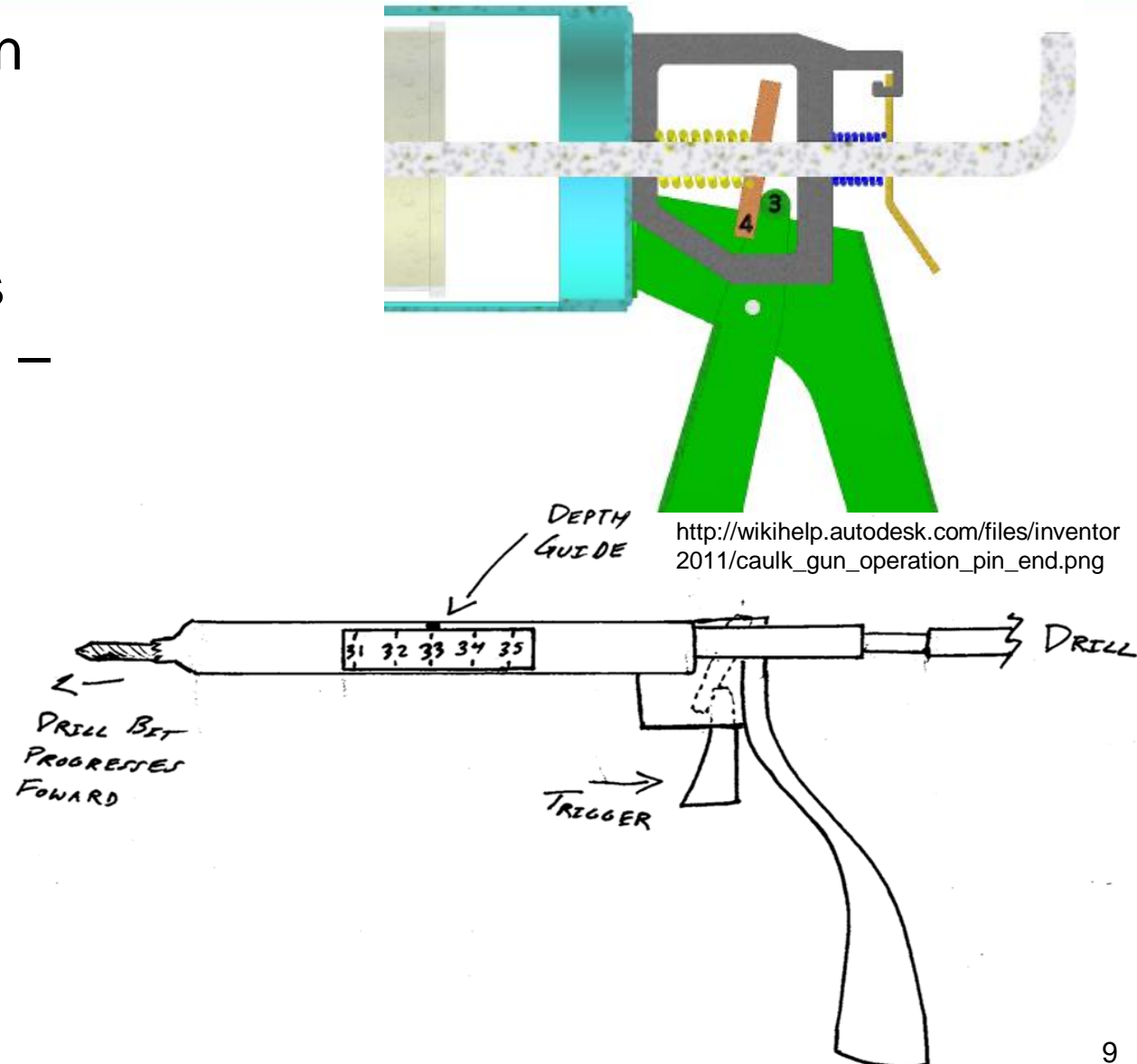
<http://www.cnccookbook.com/>



Rear tube slides inward so drill bit depth is increased

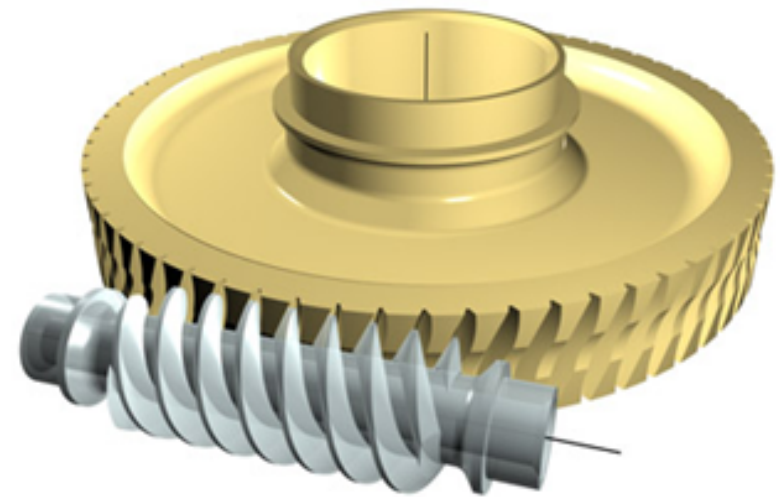
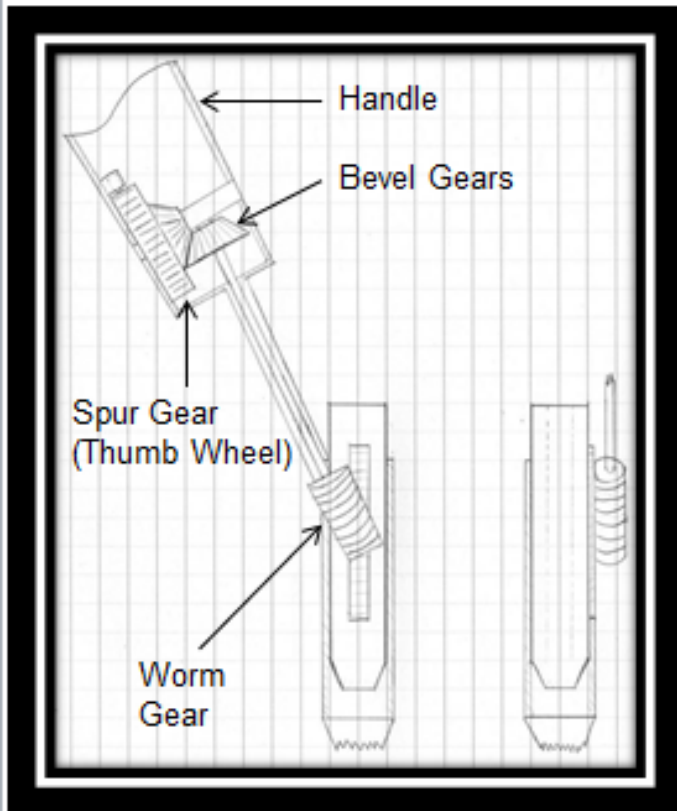
Trigger Design

- Similar to caulk gun design
- Trigger progresses drill sleeve forward – increasing depth
- Reduces plunge depth
- Ergonomic grip



Thumb Wheel Design

- Use thumb to adjust drilling depth
- Detent and indents along spur gear allow audible “click”
- Gear ratios allow for a very precise depth adjustment
- Worm gear used to produce linear translation



http://www.zakgear.com/Worm_Gear_software.html

Design Matrix

Design Characteristics	Mechanical (Trigger)	Mechanical (Thumbwheel)	Electronic Feedback	Pressure Clutch
Cost (5)	5	5	2	4
Durability (15)	13	12	10	10
Ease of Use (30)	30	25	20	22
Ease of Sterilization (10)	8	8	6	6
Precision (40)	35	38	40	35
Total	<u>91</u>	88	78	77

Future Work

- Continue work on Trigger Mechanism
- Finalize design
- Research Materials
- Begin building!
- Testing for durability, accuracy



- Allotta, Benedetto. (1997) A Hand-Held Drilling Tool for Orthopedic Surgery. *IEEE/ASME Transactions on Mechatronics*. 2 (4), 218-229.
- Dubrowski A, Backstein D. (2004) The contributions to kinesiology to surgical education. *Journal of Bone and Joint Surgery*. 86 (2), 2778-81.
- Greenburg A, inventor, 2003 Dec. 30. Sleeved stop for a drill bit. United States patent US 7,210,881.
- Ryan C, inventor, 2004 Mar. 30. Adjustable depth drill bit. United States patent US 7,163,542.

Questions?

