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4-30-14

Orthotic Screw: Saving spines one screw at a time

Purpose: To inform the audience on orthopedic screws and how specialized they are.

I. Introduction: Ace hardware screw and its price. Orthotic Zimmer screw and its price. Compare and contrast the two.
II. Orthotic screws
    A. Application
        1. [SPINE DIAGRAM]
        2. Grade 1-4 spondylolisthesis
    B. Background
        1. The Sequoia Pedicle Screw System
        2. Zimmer Spinal

III. Chemical composition/Percent composition
    A. Correct Alloy Name
        1. Ti-6Al-4V
        2. Grade 23, ELI- Extra Low Interstitial
    B. What elements are in it?
        1. Aluminum
            a.) 5.5-6.5%
            b.) Strength and Corrosion
        2. Vanadium
            a.) 3.5-4.5%
            b.) To stop corrosion of the titanium
            c.) niobium used now alternatively
        3. Titanium
            a.) Balance
            b.)Isn't easily rejected by the body, (osseointegrate)
            c.) Main strength
        4. Iron
            a.) 25%
            b.) Impurity
        5. Oxygen
            a.) .13%
            b.) impurity
        6. Nitrogen
            a.) .05%
            b.) Impurity
        7. Hydrogen
            a.) .012
            b.)Impurity
        8. Carbon
            a.) .08%
            b.) Impurity

IV. Mechanical Properties

A. Tensile strength

1. The ability to withstand stress in tension, or pulling apart
2. The screw can't break when getting put in, or get broken being pulled out
3. Cannot cause more damage by screw breakage.
4. [GRAPHIC]

B. Torsional strength

1. The ability to resist shear stress in rotation
2. Strength of screw must match torque of tools
3. [GRAPHIC]

C. Hardness

1. A measure of resistance to penetration and deformation
2. Have to have lower hardness so nerve system is not affected.
3. [GRAPHIC]
4. Hardness values
5. Density

G. Ductility

1. The ability of a material to bend stretch, or distort without breaking
2. The engineers want the implant to bend with the body so it doesn't cause Major discomfort
3. [GRAPHIC]

H. Shear Strength

1. Two opposing forces acting on a material
2. with people that have a Grade 3 and Grade 4 spondyloisthesis
3. [SPINE DIAGRAM]

V. Other properties

A. Corrosion resistance

1. The ability to protect itself from chemicals in the environment
2. This is important because the part needs to be able to last a long period of time and maintain its properties
3. [GRAPHIC]

B. Stress/Strain Relationship

1. The amount of effort attempting to fracture an item
2. Is the ratio of deformation to original length
3. The Modulus for elasticity is 120 GPa

VI. Manufacturing Process

A. Traditional Manufacturing

1. Cold Heading
   a. Wire is fed from a mechanical coil through a machine to where it is straightened.
   b. The wire gets cut to the specific length then the machine die cuts the head of the screw blank into a preprogrammed shape.
2. Thread Rolling
   a. Once cold headed, the screws are automatically fed through a machine that has wheels that roll onto the screw.
   b. The wheels have groves and when rotated and pressed onto the titanium they thread it to the machines standards.

B. Electron Beam Melting
    1. [Video] (To show what EBM looks like)
    2. Verbally explain video
        a. Not Heat treated
        b. Once its built its done and looked at for scale

VII. Conclusion - Titanium alloys are unique, not only its characteristics but its naming system. The processes used to make orthopedic screws differ as well. From rolling the threads like you would for a standard steel screw to 3-D printing one from a CAD design. The process is costly but with where it is going and its properties it has to maintain it’s worth the cost.