S3® PROXIMAL HUMERUS PLATING SYSTEM

Surgical Technique
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Introduction

DePuy Orthopaedics’ experience in developing implants for fracture fixation through locked plating technology has been used to design the S³® plate for the management of proximal humerus fractures. The S³ Proximal Humerus Plate takes full advantage of the principle of spatial subchondral support successfully applied in the design of its sister product, the DVR® Anatomic distal volar radius plate.

The S³ system is designed around the natural anatomy of the proximal humerus to address varus collapse. Convergent and divergent fixed angle pegs are centered around the natural 135° neck-shaft angle of the proximal humerus. The central guiding k-wire provides visual confirmation for plate positioning, ensuring that the pre-determined peg trajectories will provide consistent spatial distribution within the humeral dome. This unique concept of humeral fixation helps resist varus forces throughout the full range of motion.

The S³ plate has been designed to help prevent subacromial impingement. The unique design of the S³ allows the plate to be positioned more distally, minimizing the risk of impingement.

The S³ pegs and screws utilize blunt smooth ends so that fixation can be provided directly below the hard articular shell. Engaging the subchondral bone with blunt fixation and the use of a manually inserted blunt-tipped drill bit, reduces the risk for articular surface penetration.

Intended Use

The S³ Proximal Humerus Plate is indicated for fractures and fracture dislocations, osteotomies, and non-unions of the proximal humerus.

Surgical Approach

Proximal Humeral fractures are treated with the S³ through the deltopectoral approach.
Minimizes Subacromial Impingement

- The S³ plate is designed to be positioned approximately 3.0 cm distal to the greater tuberosity helping to prevent subacromial impingement.

Minimizes Varus Collapse

- The parametric design of the pegs distribute the loads more anatomically through the full range of motion by maintaining the neck shaft angle of 135° minimizing the risk of varus collapse.

Provides Strong and Secure Fixation

- The proximal end of the S³ plate has fixed angle locking pegs/screw holes. Its parametric design of convergent and divergent screw trajectories ensures a consistent spatial distribution of the pegs within the entire humeral head. This particular distribution provides spatial subchondral support to resist varus forces throughout the full range of motion.

- 4.0 mm blunt tipped subchondral support smooth or threaded pegs, provide stability while preventing protrusion through the articular surface.

- Proximal and distal locking pegs and screws provide a strong interface for a stable fixation.
Ease of Use

F.A.S.T. Guide® Technology

Central K-wire
Central K-wire hole provides a guide for initial plate positioning through the use of fluoroscopy and temporary fixation.

Suture Holes
Suture holes allow for simplified tuberosity repairs after humeral head fixation through frontal and lateral access.

User Friendly System Design
Intuitive set layout and simple instrumentation allow for convenience in surgery.
Deltopectoral Approach

Patient positioning and approach
The procedure can be performed in the beach-chair position or supine position (Figure 1) as per the surgeon’s discretion. If necessary, a sterile mayo stand can be used to assist during dissection.

Assess the fracture fluoroscopically.
Examine the fracture based on intraoperative fluoroscopy. Internal rotation, external rotation and sometimes axillary views are necessary.

Exposure
Make an incision approximately 12–14 cm over the coracoid process, extending down to the deltoid insertion in an oblique fashion. Identify and retract the cephalic vein.

Note: Taking the cephalic vein medially provides additional protection against perforation during drilling.
Identify the Biceps Tendon
Gently retract the coracobrachialis medially. Find the pectoralis insertion at the floor of the deltoid pectoralis interval. If necessary, release the proximal third of the pectoralis tendon to expose the biceps.

Complete Exposure
Develop the subacromial space and mobilize the proximal deltoid.

*Note: Use of a large, blunt humeral head depressor can facilitate exposure.*

Fracture Debridement and Reduction
Reduce the humeral head fragments using traction and manipulation and check the reduction under fluoroscopy.

*Note: In the case of severe comminution, suturing the rotator cuff together will help reduce the tuberosities. To facilitate healing, bone graft should be considered.*
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Plate Positioning
Select the appropriate side plate (lime=left; rose=right) and length (3,4,6,8,11 or 14 hole).

Position the plate 2.5–3.0 cm distal to the greater tuberosity. The anterior border of the plate (straight border) should be immediately lateral to the bicepital groove.

Drill Central K-Wire
Drill the 2.0 mm K-wire (Cat No KW20SS) through the central K-wire hole on the proximal portion of the plate aiming the center of the humeral head.
Verify Central K-Wire
Check the trajectory of the central K-wire under fluoroscopy. If there's a deviation from the center of the humeral head remove the K-wire and redrill until the center is reached.

*Note: Other distal K-wire hole can be used to aid in fracture reduction and provisionally fix the plate to the bone.*

Distal Plate Provisional Fixation
Drill through the oblong hole of the plate shaft with the 2.8 mm Drill Bit (Cat No DB28), using the Soft Tissue Protector (Cat No SSTG).

Determine the required screw depth using the Depth Gauge (Cat No SBDG).
Fix the plate into place with a 3.8 mm Multidirectional Cortical Screw (Cat No MDXX) using the Hex Driver (Cat No FHDS).

*Note: Do not fully tighten the screw to allow for later plate adjustments.*

**Proximal Plate Fixation**

Drill through the inferior anterior F.A.S.T. Guide with the 4.0 mm Short Drill Bit (Cat No FDB40S), and perforate the cortex. The drill bit has a stop that will only allow it to penetrate the near cortex.

*Note: The K-wire can be bent to avoid drill bit obstruction.*

*Note: To aid with peg engagement, start with the anterior and posterior inferior peg holes first, and then finish by drilling the remaining proximal holes in a crisscross, opposing fashion.*

**Manual Drill for Subchondral Support Pegs**

To prevent the drill from protruding through the rear cortex the following step should be made by manual drilling.

With the 4.0 mm Long Drill Bit (Cat No FDB40L or FDS40) attached to the Driver Handle (Cat No QCH), advance through the proximal plate hole F.A.S.T. Guide until resistance from subchondral bone is felt. This will ensure the peg engages subchondral bone for optimal fixation.

*Note: Do not use powered drilling for inserting the subchondral pegs. When manual drilling for smooth pegs use FDB40L. When manual drilling for partially threaded pegs use FDS40.*
Determine Peg Length
Once resistance is felt, fluoroscopy imaging should verify that the tip of the manual drill is close to the subchondral bone. Care should be taken not to penetrate the subchondral bone. Use the appropriate side of the dual scale drill bit to determine the correct peg size.

Note: If a F.A.S.T. Guide was removed before the screw length was recorded, insert the 4.0 mm Drill Guide (DRGSH) and measure using the appropriate side of the dual scale stepped Depth Gauge (Cat No FSDGS).

Peg Insertion
Remove and discard the respective F.A.S.T. Guide and insert the appropriate size peg using the Hex Driver (Cat No FHDS).

Note: If the pegs do not engage initially, re-insert the F.A.S.T. Guide or drill guide (Cat No DRGSH) and drill again using the hand drill (Cat No FDB840L)
Surgical Technique

Attach Tuberosities to Plate
Secure the tuberosities to the plate by passing the needles close to the insertion of the tendon and then through to side, front or top loading wire attachment points found on the proximal end of the plate.

Note: An alternate approach is to apply the sutures to the plate prior to placing the subchondral support pegs. This may aid in reduction.

Insert Distal Screws
Use the appropriate end of the Soft Tissue Protector (Cat No SSTG) and drill to the far cortex with the 2.8 mm Drill Bit (Cat No DB28). Measure with the Barrel Depth Gauge (Cat No SBDG).

Fix the remaining Shaft Cortical Screws with either 90º Locking Screws (Cat No NLXX) or Multidirectional Screws (Cat No MDXX).

Use a Set Screw (Cat No NLSS) to lock each 90º Screw to the plate. Do not use a set screw when using Multidirectional Screws.
Final Verification
Evaluate the humerus under fluoroscopy to assess the reduction and to confirm proper plate positioning.
Ordering Information

Pegs and Screws

Smooth Peg, Locking
Provide spatial subchondral support.
Cat No STPXX
20, 25 and 30–65 mm lengths (2.5 mm steps)

Threaded Pegs, Locking
Help to capture and lag the humeral head.
Cat No STPTXX
20, 25 and 30–65 mm lengths (2.5 mm steps)

90˚ Cortical Screws, Non-locking
Provide bi-cortical fixation while locking to the plate using the NLSS set screws.
Cat No NLXX
20 mm – 38 mm lengths (2.0 mm steps)

Multi-directional Cortical Screws, Non-Locking
Provide multi-directional fixation when used through the oblong hole.
Cat No MDXX
20 mm – 38 mm lengths (2.0 mm steps)

90˚ Locking Set Screw
Secures the 90˚ lock distal screws to the plate.
Cat No NLSS

S3® Proximal Humeral Plating System Options

Lime=Left; Rose=Right

S3® Plate, 3 Holes:
16 mm x 71 mm
SSPL3 / SSPR3

S3® Plate, 4 Holes:
16 mm x 84 mm
SSPL4 / SSPR4

S3® Plate, 6 Holes:
16 mm x 108 mm
SSPL6 / SSPR6

S3® Plate, 8 Holes:
16 mm x 150 mm
SSPL8 / SSPR8

S3® Plate, 11 Holes:
16 mm x 190 mm
SSPL11 / SSPR11

S3® Plate, 14 Holes:
16 mm x 236 mm
SSPL14 / SSPR14

The S3 plate, pegs and screws are manufactured from 316L Stainless Steel
### Top Tray

<table>
<thead>
<tr>
<th>#:</th>
<th>Description</th>
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<tbody>
<tr>
<td>1</td>
<td>SSTG Soft Tissue Guide</td>
</tr>
<tr>
<td>2</td>
<td>DB28 Drill Bit 2.8 mm</td>
</tr>
<tr>
<td>3</td>
<td>SBDG Depth Gauge</td>
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<tr>
<td>4</td>
<td>FHDS Hex Driver</td>
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<tr>
<td>5</td>
<td>FDB405 Drill Bit 4.0 mm Short</td>
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<tr>
<td>6</td>
<td>DRGSH Drill Guide 4.0 mm</td>
</tr>
<tr>
<td>7</td>
<td>FDS40 Drill Bit 4.0 mm Step</td>
</tr>
<tr>
<td>8</td>
<td>QCH Quick Connect Handle</td>
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<tr>
<td>9</td>
<td>FDB40L Drill Bit Fast 4.0 mm Long</td>
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<tr>
<td>10</td>
<td>SDI Square Driver Insert 2.0 mm</td>
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<tr>
<td>11</td>
<td>FSDGS Depth Gauge Step Shoulder Fast</td>
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<tr>
<td>12</td>
<td>MQC Mini Quick Connect Handle</td>
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<tr>
<td>13</td>
<td>KW20SS K-wire 2.0 mm SS</td>
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</tbody>
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### Bottom Tray

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<tr>
<th>#:</th>
<th>Description</th>
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<tbody>
<tr>
<td>14</td>
<td>SSPL03 3 Hole Plate, Left</td>
</tr>
<tr>
<td>15</td>
<td>SSPL04 4 Hole Plate, Left</td>
</tr>
<tr>
<td>16</td>
<td>SSPL06 6 Hole Plate, Left</td>
</tr>
<tr>
<td>17</td>
<td>SSPL08 8 Hole Plate, Left</td>
</tr>
<tr>
<td>18</td>
<td>SSPL14 14 Hole Plate, Left</td>
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<tr>
<td>19</td>
<td>SSPL11 11 Hole Plate, Left</td>
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<tr>
<td>20</td>
<td>SSPR03 3 Hole Plate, Right</td>
</tr>
<tr>
<td>21</td>
<td>SSPR04 4 Hole Plate, Right</td>
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<td>22</td>
<td>SSPR06 6 Hole Plate, Right</td>
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<tr>
<td>23</td>
<td>SSPR08 8 Hole Plate, Right</td>
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<td>24</td>
<td>SSPR11 11 Hole Plate, Right</td>
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<tr>
<td>25</td>
<td>SSPR14 14 Hole Plate, Right</td>
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**SNP® Shoulder Nail Plate**

- The SNP Anatomic Plate Module Tray contains all necessary SNP Anatomic Plate components
- All other instruments and pegs/screws are found in the S³ Proximal Humeral Tray System

The SNP™ Proximal Humeral Plating System provides the surgeon with a less invasive option than the S³ Proximal Humerus plate for fractures of the proximal humerus. The SNP combines the proximal stability of fixed angle locking pegs and suture attachments with the minimal soft tissue disruption of an intramedullary nail.
S³® Proximal Humeral Plating System

Important:
This Essential Product Information sheet does not include all of the information necessary for selection and use of a device. Please see full labeling for all necessary information.

Indications:
It is indicated for fractures and fracture dislocations, osteotomies, and non-unions of the proximal humerus.

Contraindications:
If any of the following are suspected, tests are to be performed prior to implantation. Active or latent infection. Sepsis. Insufficient quantity or quality of bone and/or soft tissue. Material sensitivity. Patients who are unwilling or incapable of following post operative care instructions.

Warnings and Precautions:
• Although the surgeon is the learned intermediary between the company and the patient, the important information conveyed in this document should be conveyed to the patient. The patient must be cautioned about the use, limitations and possible adverse effects of these implants. The patient must be warned that failure to follow postoperative care instructions may cause the implant or treatment to fail.
• An implant must never be reused. Previous stresses may have created imperfections that can potentially lead to device failure. Protect implant appliances against scratching or nicking. Such stress concentration can lead to failure.
• Orthopaedic instrumentation do not have an indefinite functional life. All re-usable instruments are subjected to repeated stresses related to bone contact, impaction, routine cleaning and sterilization processes. Instruments should be carefully inspected before each use to ensure that they are fully functional. Scratches or dents can result in breakage. Dullness of cutting edges can result in poor functionality. Damaged instruments should be replaced to prevent potential patient injury such as metal fragments into the surgical site. Care should be taken to remove any debris, tissue or bone fragments that may collect on the instrument. Most instrument systems include inserts/trays and a container(s). Many instruments are intended for use with a specific implant system. It is essential that the surgeon and operating theatre staff are fully conversant with the appropriate surgical technique for the instruments and associated implant, if any.
• Use fluoroscopy to prevent unintentional penetration of subchondral bone.
• The distal end of the pegs should be 3-6 mm below the subchondral plate. Readjust as necessary.
• Do NOT use unicortical screws (SNUS) with the shoulder plates. Use the SNUS with the SNP and the MD and NL series multi-directional and locking screws with the shoulder plates.
• Ensure removal of all F.A.S.T. Guide™ inserts after use.
• Do NOT permanently implant K-wires through the holes of the plate as they may back out and cause tissue damage. Use of the K-wires allows you to provisionally secure the plates to the anatomy.
• Supply a sufficient amount of torque to the pegs to ensure that each is fully seated. If not seated properly, remove, re-drill and reinsert the peg until fully seated. The head of the peg should sit beneath the surface of the plate to avoid soft tissue irritation.
• During insertion, if the tail of the SNP bends, remove the implant, straighten the tail and reinsert.

Adverse Effects:
The following are possible adverse effects of these implants: potential for these devices failing as a result of loose fixation and/or loosening, stress, excessive activity, load bearing particularly when the implants experience increased loads due to a delayed union, nonunion, or incomplete healing. Failure to follow postoperative care instructions may cause the implant or treatment to fail.

NOTE: Do NOT remove F.A.S.T. Guide® inserts prior to sterilization