Elbow Plating System
Acumed® is a global leader of innovative orthopaedic and medical solutions.

We are dedicated to developing products, service methods and approaches that improve patient care.

Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introducing the System</td>
<td>2</td>
</tr>
<tr>
<td>Elbow Plating System Features</td>
<td>3</td>
</tr>
<tr>
<td>Olecranon Plate Features</td>
<td>4</td>
</tr>
<tr>
<td>Coronoid Plate Features</td>
<td>4</td>
</tr>
<tr>
<td>Distal Humerus Plate Features</td>
<td>5</td>
</tr>
<tr>
<td>Posterolateral Plates</td>
<td>6</td>
</tr>
<tr>
<td>Parallel Plate Placement</td>
<td>7</td>
</tr>
<tr>
<td>Biomechanics</td>
<td>7</td>
</tr>
<tr>
<td>Precontoured Plates</td>
<td>9</td>
</tr>
<tr>
<td>Instrumentation</td>
<td>9</td>
</tr>
<tr>
<td>Hexalobe Screw System</td>
<td>10</td>
</tr>
<tr>
<td>Tap-Loc® Technology</td>
<td>11</td>
</tr>
<tr>
<td>Tap-Loc® Technology</td>
<td>12</td>
</tr>
</tbody>
</table>

Acumed® is committed to keeping pace with the ever-changing needs of orthopaedic surgeons. As surgeons develop new methods of fracture fixation and rehabilitation, we continue to develop new advancements in our orthopaedic implants and technology. One of these advancements, the Elbow Plating System, has revolutionized the way orthopaedic surgeons treat and manage elbow fractures. Designed in conjunction with Shawn W. O’Driscoll, Ph.D., M.D., the Elbow Plating System is designed to address fractures of the distal humerus, olecranon and coronoid.

The Elbow Plating System offers precontoured, indication specific plates and includes an innovative low-profile Olecranon Plate design with increased anatomic features and instrumentation to ease plate and screw insertion. This system also features the Hexalobe Screw System with variable angle Tap-Loc® Technology for the Medial and Lateral Distal Humerus Plates. An innovative line of Posterolateral Plates are offered in addition to our Medial and Lateral Distal Humerus Plates to make this system a comprehensive solution for elbow fracture management.

The Elbow Plating System exemplifies our dedication to designing implants and instrumentation that maximizes the capabilities of current and new fixation techniques and provides the best possible outcome for the patient.

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Precontoured Plate design may eliminate the need for surgeons to bend the plates to match the anatomy of the patient. For complex fractures, the plates act as a template to restore the natural anatomic geometry of the distal humerus and proximal ulna.

Parallel Plate Placement provides a more stable construct than plates placed at a 90° orientation. Biomechanical data shows that parallel plate placement has greater strength and stability, especially when the elbow is subjected to A/P and torsional forces. In addition, a Posterolateral Distal Humerus Plate family is available to make this a fully comprehensive system.

Hexalobe Screw System was designed specifically for fractures of the elbow. Variable Angle Tap-Loc® Technology allows up to 20° screw angulation, providing flexibility when capturing fracture fragments while maintaining the benefits of a traditional locking screw.
Olecranon Plates

Locking Olecranon Plates provide excellent fixation in the proximal ulna for both fractures and osteotomies. The plates feature an advanced anatomic design which contours proximally and along the shaft to provide a precise anatomic fit as well as a lower profile design than previous generation plates.

Left and right-specific plates improve anatomic fit proximally and distally along the ulnar shaft. The locking screw trajectory allows screws to capture fracture fragments without interference with other locking screws. Increased plate length range makes this a comprehensive plate offering for olecranon fractures.

Prongs on the proximal tip of the Standard Plates provide provisional fixation into the triceps tendon, assisting with reduction and improving final stability. The plate is placed directly over the triceps tendon, eliminating the need for a triceps split. A 3-hole plate is included for osteotomies and more proximal olecranon fractures that do not require a longer plate length. A radiolucent targeting guide for the proximal 2.7 mm screw cluster eases the surgical technique and may help to save valuable procedure time. K-wire holes facilitate provisional plate fixation.

The Extended Plate family does not have prongs and is offered for the treatment of fractures that extend proximally. The proximal three holes are threaded to allow locking screws to be utilized. With the Extended Plates, the surgeon may choose several proximal locking screw options depending on the fixation needed for the particular fracture pattern. An angled “home run” screw in hole #3 or a long intramedullary screw in hole #2 may be utilized along with smaller fragment screws in the other proximal holes.

Optional Narrow Plates provide a more precise fit for patients less than 120lbs (54 kg). They are specifically designed to fit smaller bone geometry. An optional 15-hole plate is available for the treatment of segmental fractures or where comminution extends distally along the ulnar shaft.

Olecranon Plate lengths range from 65 mm to 190 mm.

Coronoid Plates

Designed specifically for fractures of the anteromedial facet of the coronoid, the Acumed® Coronoid Plates act as a buttress to the coronoid, while also counteracting the tendency of the elbow to subluxate. The plates are low-profile and contour to the patient’s anatomy. Holes are included in the buttress portion of the plate as well as an offset screw hole that captures fractures of the sublime tubercle. Offered in both left (blue) and right (green), these plates are available in a small and standard size. They range in width from 20 mm to 21 mm and in length from 31 mm to 35 mm.
**Distal Humerus Plates**

Precontoured in three planes, the Locking Distal Humerus Plates offer multiple lengths and sizes to treat a wide variety of fractures. Both parallel and Posterolateral Plate options are available to make this a fully comprehensive system for distal humerus fractures.

**Lateral Column Plates**

These plates improve upon posterior plating biomechanically by enabling the use of longer screws that interdigitate with screws coming from the medial side. The Lateral Plates are offered in both left (blue) and right (green) and are 11 mm in width and 2.0 mm at the thickest point. Lengths range from 58 mm to 206 mm.

**Medial Column Plates**

Distally these plates extend down to, or wrap around the medial epicondyle or even extend down onto the medial trochlea. Extending up the condylar ridge, these locking plates offer solid fixation and compression. This fixation is maximized when the screws in the articular fragments can interdigitate with those coming from the lateral side. The Medial Plates are 11 mm wide and 2.0 mm at the thickest point and offer 2-4 screw holes for fixation of the articular fragments. Lengths range from 84 mm to 175 mm.

**Posterolateral Plates**

These plates are designed for isolated capitellar fractures and for surgeons who prefer a 90-90 plate application. The precise anatomic curvature of the plate ensures the proper fit for the patient. The diverging screw geometry in the distal cluster allows for the maximum amount of fixation at the fracture site. The Posterolateral Plates are offered in both left (blue) and right (green) and are 10.7 mm in width and 4.6 mm at the thickest point. Plate lengths range from 80 mm to 205 mm.
The Posterolateral Plates make the Acumed® Elbow Plating System a comprehensive solution for distal humerus, olecranon and coronoid fractures.

The plates were specifically designed to have a precise anatomic fit and to include a unique screw geometry that is intended to optimize the maximum amount of fixation at the fracture site. The cluster of distal screws is angled distally and divergent from one another to allow the plate to sit more proximally in order to avoid potential impingement on the olecranon and to best capture the fracture fragments.

These plates have a proximal taper intended to reduce stress concentrations, K-wire holes for provisional fixation and a limited contact design intended to maintain blood flow to the periosteum.

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The parallel placement option for our Locking Distal Humerus Plates provides a strong, stable construct which may reduce the need for immobilization of the elbow for an extended postoperative period. The strength of the plates, along with the parallel application and locking technology, may reduce the chance of hardware failure. The patient may be able to begin rehabilitation and range of motion exercises immediately after surgery.

Because screws come from opposing sides of the condyles, long screws are able to interdigitate in the distal fragments, creating an “arch” construct. The interdigitating screws provide the keystone to the arch, creating a stable construct to facilitate with immediate, aggressive rehabilitation.

A comprehensive study proved that plates placed in a parallel configuration on the medial and lateral columns were stronger than 90° plating when a gap was present between the articular fragments and the shaft, as when the humerus is severely fractured. An earlier study compared 90° plating to a Y-plate and crossed screws, but did not compare “perpendicular” to “parallel” plating. The newer study found “parallel” plating to be the best construct for reconstruction of a comminuted distal humerus. Both studies were written before the introduction of the Elbow Plating System which optimizes the biomechanics even further with locking capability, plate placement and plate strength.

Finite element analysis testing at Acumed indicated advantages of parallel plating versus 90° plating. For this study, reconstruction plates and tubular plates were used in comparison with Acumed’s parallel plating system. A computer modeled distal humerus was tested with competitor (90 degree) plating vs. Acumed’s parallel plating. The program simulated a load of 50lbs in three different planes: A/P, M/L, and Torsion. The results supported parallel plating, especially in torsional loads.

90° Plating Displaced:

Anterior/Posterior: 53% more
Medial/Lateral: 5% less
Torsion: 80% more

References
Results of a biomechanical study tested perpendicular 3.5 mm LCP Distal Humerus Plates (316L) versus parallel Locking Distal Humerus Plates (titanium) for stiffness in compression and internal/external rotation, plastic deformation and failure in torsion. Both systems were utilized for fixation of a distal intra-articular humerus fracture with a metaphyseal comminution in osteoporotic bone. Results showed that the Acumed® parallel locking system showed improved stability compared with the perpendicular locking system, and therefore may be more indicated.\textsuperscript{7}

Locking Distal Humerus Plates provided higher stability in compression and external rotation, and a greater ability to resist axial plastic deformation.

- Axial compressive stiffness of our plates was 2.3 times greater than the perpendicular locking system.
- The perpendicular locking plates experienced an average of 2.9 times greater axial plastic deformation than the Acumed® plates.

The Acumed® Locking Olecranon Plates are Grade 4 unalloyed titanium. Our previous generation Olecranon Plates are Grade 2 unalloyed titanium. Because Grade 4 unalloyed titanium has higher yield strength, the plates are able to be lower profile than our previous generation of plates without compromising strength.

Mechanical testing of our Locking Olecranon Plates versus previous generation Olecranon Plates was performed utilizing two separate loading scenarios for metaphyseal and diaphyseal plate strength. Both scenarios investigated direct load to failure of the plate. Failure of the plate was considered to have occurred when permanent plastic deformation of the plate occurred.

The Acumed® Grade 4 unalloyed titanium Olecranon Plates have a 6% lower profile than our Grade 2 unalloyed titanium Olecranon Plates. Testing results showed mean failure load of the Grade 4 unalloyed titanium plate is statistically equal to the mean failure load of the existing Grade 2 unalloyed titanium plate in proximal cantilever bending. Results of the second loading scenario showed mean failure load of the Grade 4 unalloyed titanium plate is statistically greater by 16% than the mean failure load of the existing Grade 2 unalloyed titanium plate in diaphyseal four-point bending.\textsuperscript{8}

References
The Elbow Plating System offers a comprehensive range of precontoured plates that provide fixation in the articular fragments, contributing to the stability of the entire reconstruction.

- Plates are precontoured to match the natural anatomy of the elbow, minimizing the need for surgeons to bend the plates prior to application.
- For complex fractures, the plates act as a template for anatomic restoration of the elbow.

In addition, the plates are designed to maximize stability of peri-articular fragments and facilitate rehabilitation. Clustered screw holes in the articular region increase stability and strengthen the reconstruction. This improved stability allows the plates to compress these articular fragments with the shaft to achieve union of the fracture fragments. Plate profile and screw/plate interface were designed with the soft tissues in mind. The plates taper in the peri-articular region and the screw heads are recessed within the low-profile plates.

Plate thickness is optimized for each region of the bone. Continuous change in thickness provides strength along the metaphysis/diaphysis where it is needed, while maintaining a low-profile in the peri-articular areas with limited soft tissue coverage.

In addition to the innovative features of the implants, Acumed® designed the system for ease of use by providing all surgical instrumentation in a well-organized tray.

- The Osteotomy Cutting Jig is an instrument unique to the Acumed® Elbow Plating System. The Cutting Jig provides four location options to start the chevron osteotomy of the olecranon and also provides pre-drilling capability for future Olecranon Plate application.
- Color-coded instrumentation allows for quick identification of proper drills, taps, driver tips and drill guides in the system for each screw diameter. An improved screw caddy design provides a durable all metal design, a removable caddy lid and user friendly handles for quick removal from the system tray. All screw diameters are bordered by colors that correspond with the color bands on the appropriate instrumentation. The Elbow Plating System features a user friendly depth gauge design as well as “Tri-Flat” Locking Drill Guides that allow one-step drilling and depth measurement.
- The Targeted Drill Guide enables surgeons to drill and position the distal screws in the Medial and Lateral Distal Humerus Plates with confidence and accuracy. The drill guide cannula is placed in the appropriate plate hole and the tip of the guide is positioned in the desirable location of the screw’s ending point.

References
Hexalobe Screw System
Hex Versus Hexalobe
Comparison of Acumed® Hex and Hexalobe Screws

The Elbow Plating System features the Hexalobe Screw System. The Hexalobe Screws were designed specifically with elbow fractures in mind. These screws have maximized strength and a Hexalobe drive interface to optimize performance in dense bone, especially when longer length screws are necessary.

**Sleeveless “Stick-Fit” Screw/Driver Interface**

The design of the Hexalobe driver allows the driver to stick in the screw, obviating the need for a screw sleeve and reducing procedure time.

**Modified Screw Root and Taper**

Additional material on the screw root diameter and a larger wall thickness around the screw head gives the modified driver/screw interface additional strength to reduce breakage.

**Additional Cutting Flutes**

Acumed® Hex Screws only have one cutting flute to aid insertion. The Hexalobe System provides three cutting flutes on our longer screws (34 mm and up) to help ease screw insertion.

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### Increased Torque Strength*

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<thead>
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<th>Screw Type</th>
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<tbody>
<tr>
<td>3.5 mm Hex</td>
<td>+23%</td>
</tr>
<tr>
<td>3.5 mm Hexalobe</td>
<td>+58%</td>
</tr>
<tr>
<td>2.7 mm Hex</td>
<td>+19%</td>
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* Testing on file

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### Increased Root Diameter of Screws

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<th>Screw Type</th>
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<tr>
<td>3.5 mm Hex</td>
<td>+23%</td>
</tr>
<tr>
<td>3.5 mm Hexalobe</td>
<td>+17%</td>
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Acumed\textsuperscript{®} believes that surgeons should have the ability to determine the trajectory of the locking screws in the distal humerus. Our Medial and Lateral Distal Humerus Plates offer patented Tap-Loc\textsuperscript{®} Technology, allowing surgeons to choose the optimal locking screw trajectory in the distal fragments. This provides surgeons with the ability to maximize fixation in the distal fragments. It also offers multidirectional screw angles to give surgeons the freedom to angle the distal locking screws up to 20° in each direction. This provides flexibility when capturing fracture fragments while maintaining the benefits of a traditional locking screw.

Dr. O’Driscoll’s goal was to combine his principles for distal humeral fracture fixation with variable angle locking technology. Because anatomy and fracture patterns in the distal humerus vary from patient to patient, he saw the importance of allowing the surgeon to choose the angle of the distal locking screws for both our Medial and Lateral Plates. In addition, the locking threads of each locking screw should accurately coincide with the threads in the plate to ensure maximum locking strength and stability and avoid cross-threading screws into plates like other variable angle locking methods.

Mechanical testing was performed to provide a comparative strength analysis of Acumed\textsuperscript{®} Locking Hexalobe Screws used in pre-threaded holes, holes tapped at 0° from the centerline of the hole using Tap-Loc\textsuperscript{®} Technology, and holes tapped at 20° from the centerline of the hole using Tap-Loc\textsuperscript{®} Technology. Results showed that a Hexalobe Screw installed using Tap-Loc\textsuperscript{®} Technology at 20° can sustain a load up to 90\% of the failure load of a screw installed in a pre-threaded hole and Hexalobe Screws installed using Tap-Loc\textsuperscript{®} Technology at 0° were equal in strength to the pre-threaded holes\textsuperscript{10}.

To learn more about the full line of innovative solutions from Acumed\textsuperscript{®}, including our Elbow Plating System, visit www.acumed.net.

References
Tapping Threads
allow surgeons to tap the plate after drilling, creating threads in the plate and bone for locking screw insertion.

Quick Release
instrumentation provides an efficient way to switch from 3.5 mm to 3.0 mm plate taps.

Laser Mark
indicates maximum tapping depth.

Tapping Instructions:
- Do not tap deeper than the start of the laser line
- Clean debris from tap after tapping each hole
- Irrigate hole prior to tapping
- Do not tap a slot
- Do not re-tap a hole (use a nonlocking screw)
- Tap by hand, not under power
- Angle of tapped hole must not exceed 20°

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