### Supplementary file 4

**Article title**  Complications after surgical management of proximal humeral fractures: a systematic review of event terms and definitions  
**Journal name**  BMC Musculoskeletal Disorders  
**Author names**  Alispahic N, Brorson S, Bahrs C, Joeris A, Steinitz A, Audigé L  
**Corresponding author**  Laurent Audigé, Schulthess Klinik, CH-8008 Zurich, Switzerland  
**e-mail address**  laurent.audige@kws.ch

### Extracted definitions related to specific event terms

**Malunion**

| Authors            | Year | Term Used | Definition                                                                                   | Adapted from                                      | Cited by         |
|--------------------|------|-----------|-----------------------------------------------------------------------------------------------|---------------------------------------------------|------------------|
| Sohn et al.        | 2014 | Malreduction | Head-shaft angle $< 120^\circ$ or $> 140^\circ$, measured on immediate postoperative radiographs | Brunner et al. 2009                              | Sohn et al. 2017 |
| Bahrs et al.       | 2015 | Malunion | Residual bone deformities at time of follow-up after healing measured on AP and axillary radiographic views (varus / valgus angulation on the AP view [±15°] AND/OR anteversion or retroversion on the axillary view [±15°]) AND/OR tuberosity displacement with reference to the opposite side, with or without tuberosity displacement of $> 5$ mm | Bahrs et al. 2010 |                  |
| Okike et al.       | 2015 | Malunion | Healing in varus, valgus or translation alone                                                |                                                   |                  |
| Gracitelli et al.  | 2016 | Varus malunion | Neck-shaft angle $\leq 110^\circ$                                                                 |                                                   |                  |
| Esenyel et al.     | 2017 | Tuberosity malposition (hemiarthroplasty) | Tuberosity position of more than 5 mm above or more than 10 mm below the prosthetic head |                                                   |                  |
| Hao et al.         | 2017 | Varus malunion | Neck-shaft angle $\leq 110^\circ$                                                                 |                                                   |                  |
| Villodre-Jimenez et al. | 2017 | Arm lengthening $> 20$ mm | Difference in the acromion-epicondyle distance in the radiographic checks of the operated arm compared to the contralateral arm | Lädermann et al. 2009 |                  |

† not from the initial literature search
### Delayed healing / nonunion

| Authors                      | Year | Term Used                        | Definition                                                                 | Adapted from                     | Cited by                |
|------------------------------|------|----------------------------------|---------------------------------------------------------------------------|----------------------------------|-------------------------|
| Vannabouathong et al. 31     | 2011 | Nonunion                         | Absence of callus uniting the main fracture fragments in 3 of the 4 bone cortices |                                   | Gracitelli et al. 2016 19 |
| Papakonstantinou et al. 38   | 2017 | Delayed union / nonunion         | Delayed union = Union between 61 and 89 days; it is defined as prolonged after 90 days. Nonunion = When fractures had not united by 90 days | Sheck et al. 1982 42             |                         |

### Secondary fracture displacement

| Authors                      | Year | Term Used                        | Definition                                                                                                                                                                                                 | Adapted from                     | Cited by                |
|------------------------------|------|----------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------------------------|
| Platzer et al. 40 †          | 2005 | Tuberosity displacement          | Displacement >5mm.                                                                                                                                                                                        | Park et al. 1997 39              | Kancherla et al. 2017   |
| Ockert et al. 35 †           | 2010 | Secondary varus displacement     | Displacement >10° or the CCD angle (centrum collum diaphyseal angle)                                                                                                                                   |                                   | Handoll et al. 2015 21  |
| Bahrs et al. 7                | 2015 | Secondary fracture displacement  | Secondary fracture displacement at follow-up (defined as > 5° difference of CCD angle or > 5 mm secondary fracture displacement of the greater tuberosity under consideration of the radiographs after fracture stabilization and FU for AP and axillary views and for tuberosity displacement for the AP view). | Brunner et al. 2009 11           |                         |
|                              |      |                                 |                                                                                                                                           | Helwig et al. 2009 23            |                         |
|                              |      |                                 |                                                                                                                                           | Roderer et al. 2011 41           |                         |
| Doursounian et al. 15         | 2016 | Displacement of the humeral head | More than 10% displacement in the diameter of the humeral head (i.e. 5 mm for 50 mm diameter).                                                                                                          | Acklin et al. 2013 2              |                         |
| Doursounian et al. 15         | 2016 | Displacement of the tuberosities | 30° or more change in angle of a bone fragment                                                                                                                                                            | Sohn et al. 2014 47              |                         |
| Gonc et al. 18                | 2016 | Varus progression                | Head-shaft angle < 130° postoperatively is considered a sign of varus progression                                                                                                                             |                                   |                         |
| Gracitelli et al. 19          | 2016 | Loss of reduction of humeral head | Change of the neck shaft angle ≥ 10°                                                                                                                                                                    |                                   |                         |
### Secondary fracture displacement (continued)

| Authors            | Year | Term Used                          | Definition                                                                 | Adapted from                      | Cited by          |
|--------------------|------|------------------------------------|---------------------------------------------------------------------------|-----------------------------------|-------------------|
| Gracitelli et al. 19 | 2016 | Loss of reduction of the greater tuberosity | Displacement of the greater tuberosity ≥ 0.5 cm |                      |                   |
| Hao et al. 22       | 2017 | Loss of reduction in tuberositäes   | Displacement of a tuberosity > 5 mm                                      |                                   |                   |
| Shukla et al. 44    | 2017 | Varus re-collapse                  | In patients with an initial varus fracture pattern, neck-shaft angle < 120° as measured on an anteroposterior radiograph with 20° of external rotation. | Agudelo et al. 2007 4            |                   |
| Sohn et al. 46      | 2017 | Varus collapse                     | Significantly progressive change of the head-shaft angle with < 120° from the immediate postoperative radiograph to the final follow-up evaluation | Brunner et al. 2009 11           |                   |
| Wolfensperger et al. 55 | 2017 | Displacement                       | Migration > 5 mm compared with the postoperative radiographs              | Kralinger et al. 2004 29         |                   |

† not from the initial literature search

### Humeral head necrosis

| Authors            | Year | Term Used     | Definition                                                                 | Adapted from                      | Cited by          |
|--------------------|------|---------------|---------------------------------------------------------------------------|-----------------------------------|-------------------|
| Fjalestad et al. 17 | 2012 | Avascular necrosis | Classification system:  
2 = no changes;  
1 = changes to normal trabecular organization < 50% of humeral head;  
0 = > 50% or partial collapse | Fjalestad et al. 2014 16  
Handoll et al. 2015 21 |                   |
### Implant failure

| Authors            | Year | Term Used           | Definition                                                                                       | Adapted from                  | Cited by       |
|--------------------|------|---------------------|--------------------------------------------------------------------------------------------------|-----------------------------|----------------|
| Haasters et al. 2016 | 2016 | Loss of fixation    | Decreased head-shaft angulation of > 10° in the anteroposterior or lateral plane.            | Acklin et al. 2012 1         |                |
| Vijayvargiya et al. 52 | 2016 | Failure             | Backing out of the screw, plate breakage / pull-out, malunion, nonunion or avascular necrosis of humeral head. |                             |                |

### Screw perforation/cut out

| Authors           | Year | Term Used                          | Definition                                                                                     | Adapted from               | Cited by       |
|-------------------|------|------------------------------------|------------------------------------------------------------------------------------------------|----------------------------|----------------|
| Clavert et al. 13 | 2010 | Screw cutout                       | Results through high plate position and inadequate screw length                                  | Agudelo et al. 2007 2       | Bohsali et al. 2017 9 |
| Lopiz et al. 31   | 2014 | Protrusion of the osteosynthesis material | Subacromial protrusion with impingement or articular intrusion of the screws                      | Owsley et al. 2008 37       | Handoll et al. 2015 21 |
| Spross et al. 48  | 2014 | Secondary screw cut-out            | Locked screws do not allow any slip back and the screw tips slowly protrude through the head fragment into the joint, also known as secondary screw cut-out. | Naranja et al. 2000 33      | Ayoub et al. 2017 5  |
| Konighausen et al. 28 | 2015 | Secondary perforation (Sekundäre Perforation) | Resintering of separate screws after loss of reduction (Nachsintern einzelner Schrauben bei Repositionsverlust) | Jost et al. 2013 25         |                |
| Konighausen et al. 28 | 2015 | Primary screw perforation (primäre Schraubenperforation) | Intraoperative overlooked iatrogenic screw protrusion (Intraoperativ übersehene Schraubenüberstände, Iatrogen bedingt) |                             |                |
| Aguado et al. 3   | 2016 | Screw joint penetration            | Screw going into the joint                                                                        |                             |                |
| Brunner et al. 12 | 2017 | Primary screw perforation (primäre Schraubenperforation) | Already intraoperative apparent screw joint perforation (intraoperativ bereits ersichtliche intraartikuläre Perforation) | Brunner et al. 2009 11      | Südkamp et al. 2009 49 |
### Notching (specific radiological parameter of the reversed prosthesis)

| Authors           | Year | Term Used | Definition                                                                 | Adapted from | Cited by            |
|-------------------|------|-----------|----------------------------------------------------------------------------|--------------|---------------------|
| Hernandez et al.  | 2015 | Notching  | Notching is the erosion of the scapular neck secondary to its contact with  | Sirveaux et al. 2004 |                     |
|                   |      |           | the humeral component of the implant during upper extremity adduction.      |               |                     |
| Obert et al.      | 2016 | Groove    | A groove on the lower side of the neck of the scapula classified according  | Sirveaux et al. 2004 | Valenti et al. 2001 |
|                   |      |           | to 1) Sirveaux Classification 2) Nerot Classification                       |               |                     |

### Stiffness

| Authors           | Year | Term Used         | Definition                                                                 | Adapted from | Cited by            |
|-------------------|------|-------------------|---------------------------------------------------------------------------|--------------|---------------------|
| Sohn et al.       | 2014 | Shoulder stiffness| Limitation of active and passive motion compared to the contralateral      | Shin et al. 2013 | Sohn et al. 2017    |
|                   |      |                   | shoulder in at least two directions (forward flexion < 120° or 50%         |               |                     |
|                   |      |                   | restriction of external rotation and internal rotation compared to the     |               |                     |
|                   |      |                   | contralateral side)                                                       |               |                     |
| Bonnevialle et al. | 2016 | Stiffness         | A passive anterior elevation of less than 80°, associated or not with      |               |                     |
|                   |      |                   | a passive external rotation of the elbow at the side of less than 10° at   |               |                     |
|                   |      |                   | the final follow-up was considered to be stiffness.                        |               |                     |

### Nerve lesion

| Authors           | Year | Term Used            | Definition                                                                 | Adapted from | Cited by            |
|-------------------|------|----------------------|---------------------------------------------------------------------------|--------------|---------------------|
| Westphal et al.   | 2017 | Axillary nerve lesion| Electromyography findings were defined as suspect when the distal latency|               |                     |
|                   |      |                      | was longer or the amplitude was reduced by more than 50% compared with   |               |                     |
|                   |      |                      | the healthy shoulder.                                                     |               |                     |
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