

## Appendix

### ***Operative Technique***

A deltopectoral approach was used in all operations. In 7 patients initially treated with open reduction and internal fixation, the implant was removed. In these cases, adhesions under the deltoid muscle were systematically released. A tenotomy of the tendon of the subscapularis muscle was performed, and tenodesis of the long head of the biceps was systematically undertaken. Capsular release and detachment of the remaining labrum around the glenoid were performed beginning from the 12 o'clock position to the 7 o'clock position in the right shoulders and to the 5 o'clock position in the left shoulders. The superior, medial, and inferior glenohumeral ligaments were released. The capsule around the humeral neck was released and afterwards the proximal part of the humerus was exposed. The remaining malunited humeral head was identified and the resection guide was placed through the head. Then the head was resected using a 155° inclination guide. Remaining osteophytes were removed. The retroversion was between 0° and 20° in all cases. Hemispherical reamers were used to prepare the metaphysis. The humeral shaft was prepared with broaches. A center drill pin was inserted in the middle or at the lower third of the glenoid. Flat reamers were used to prepare the glenoid until the subchondral bone was visualized inferiorly. A hole was drilled over the central pin for the peg of the baseplate. The baseplate was impacted in press-fit fashion and was additionally stabilized by two compression and two locking screws. A 36-mm glenosphere was used in 38 cases and a 42-mm glenosphere was used in 4 cases. In 1 case, an osteotomy of the tuberosities was necessary to insert the stem. The tuberosities were fixed with multiple sutures after placement of the stem. The humeral stem was cemented in all cases but 1, and the polyethylene insert was chosen on the basis of the intraoperative tension of the deltoid and the experience of the surgeon. In 3 of the later cases (2009 to 2010), an additional transfer of the tendon of the latissimus dorsi muscle was performed. Indication for the transfer was a severe loss of external rotation of the affected shoulder. The quality of the subscapularis tendon and muscle was judged by each surgeon intraoperatively and a repair was done whenever the surgeon had the impression that this procedure would be useful. In 20 cases, a repair of the subscapularis tendon was possible and was performed by using a minimum of 5 nonabsorbable, tendon-to-tendon sutures.

Patients who were treated with a latissimus dorsi transfer were immobilized for 6 weeks in 30° of external rotation and abduction. Afterwards, shoulder motion was progressively increased. The arms of all other patients were placed in slings and pendulum exercises as well as passive anteversion up to the shoulder level were allowed immediately after the surgical procedure. External rotation was limited to 0° for 6 weeks in cases with repaired subscapularis tendons. Water gymnastics were allowed up to the shoulder level after removal of the stitches. After 6 weeks, there were no restrictions on active or passive mobility.