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Arthroscopic rotator cuff repair in the weight-bearing shoulder

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Background: In wheelchair-dependent individuals, pain often develops because of rotator cuff tendon failure and/or osteoarthritis of the glenohumeral joint. The purposes of this study were to investigate (1) specific rotator cuff tear patterns, (2) structural healing, and (3) clinical outcomes after arthroscopic rotator cuff repair in a cohort of wheelchair-dependent patients.

Methods: Forty-six shoulders with a mean follow-up of 46 months (range, 24-82 months; SD, 13 months) from a consecutive series of 61 shoulders in 56 patients (46 men and 10 women) undergoing arthroscopic rotator cuff repair were available for analysis. Clinical outcome analysis was performed using the Constant-Murley score, the Subjective Shoulder Value, and the American Shoulder and Elbow Surgeons score. The integrity of the repair was analyzed by ultrasound.

Results: Of the shoulders, 87% had supraspinatus involvement, 70% had subscapularis involvement, and 57% had an anterosuperior lesion involving both the supraspinatus and subscapularis. Despite an overall structural failure rate of 33%, the patients showed improvements in the Constant-Murley score from 50 points (range, 22-86 points; SD, 16 points) preoperatively to 80 points (range, 40-98 points; SD, 12 points) postoperatively and in the American Shoulder and Elbow Surgeons score from 56 points (range, 20-92 points; SD, 20 points) preoperatively to 92 points (range, 53-100 points; SD, 10 points) postoperatively, with a mean postoperative Subjective Shoulder Value of 84% (range, 25%-100%; SD, 17%).

Conclusion: Failure of the rotator cuff in weight-bearing shoulders occurs primarily anterosuperiorly. Arthroscopic rotator cuff repair leads to a structural failure rate of 33% but satisfactory functional results with high patient satisfaction at midterm follow-up.

Level of evidence: Level IV, Case Series, Treatment Study.

Keywords: Arthroscopic rotator cuff repair; weight-bearing shoulder; wheelchair; shoulder; rotator cuff; subscapularis; supraspinatus

The responsible institutional review board (Kantonale Ethikkommission Luzern) approved the study. Written consent was obtained from all patients willing to attend a follow-up visit. For those who did not provide written consent, on the basis of a general permit issued by the responsible state agency, our institutional review board allows retrospective analysis of patient data relating to standard diagnostic or therapeutic procedures without individual informed consent.

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Pain and/or overuse injuries of the upper extremities will develop in up to 62% of wheelchair-dependent individuals.[7] Because of intensive use of the upper extremities during transfer, torso stabilization, and wheelchair propulsion, the term ''weight-bearing shoulder'' has been established.

A 3-dimensional model has identified active wheelchair propulsion to impose a significant upward force at the shoulder,[13] and the absence of trunk innervation further increases the biomechanical stresses on the upper extremities during functional activities.[10] Wheelchair dependence also requires frequent, prolonged, and repetitive overhead reaching to access the environment from a sitting position. The overhead requirements of daily living have received little attention; recent studies, however, have shown that load during overhead movements in wheelchair users was higher than for mere wheelchair propulsion.[18] The daily living activities in wheelchair-dependent individuals involve continuous and repetitive use (overuse) of their rotator cuff muscles, and it seems reasonable to assume that structural changes of the shoulder joint are more frequent, more severe, and probably more disabling in individuals with longstanding paraplegia. The reported prevalence of rotator cuff lesions in the weight-bearing shoulder was 63% after a mean of 33.7 years of wheelchair dependency in a population with a mean age of 52 years,[1] and overall, up to 65% to 73% of wheelchair users with pain have rotator cuff tears.[2,6] Seventy-five percent of these tears were considered chronic or degenerative,[2] and etiologically, such tears are more closely related to wear and tear rather than aging.[1]

Despite these high numbers of disabling shoulder pain in wheelchair-dependent patients, there is a paucity of data available to help clinicians to decide how to treat such a problem in these high-demand patients.[8,12,16,17] The purposes of this study were therefore to investigate (1) specific rotator cuff tear patterns, (2) structural healing, (3) and clinical outcomes of arthroscopic repair in wheelchair-dependent patients.

Materials and methods

This is a retrospective case series of arthroscopic rotator cuff repairs in wheelchair-bound patients. All patients who were wheelchair dependent preoperatively and postoperatively and underwent arthroscopic repair of a full-thickness rotator cuff lesion in a dedicated unit for the study of paraplegia between 2006 and 2011 were identified from a prospectively collected institutional database and constituted the study cohort. There were 61 operated shoulders in 56 patients (46 men and 10 women) with a minimum follow-up of 24 months. The patients had a mean age of 55 years (range, 27-89 years; SD, 11 years) and had been wheelchair dependent for a mean of 23 years (range, 0.3-56 years; SD, 14 years) before surgery. The reasons for wheelchair dependence were mainly traumatic spinal cord injuries (Table I) at the thoracic level (Fig. 1).

The aforementioned patients were invited to undergo a study-specific follow-up analysis (Fig. 2). Of the 15 patients (27%) who were not available for study-specific follow-up, 6 had a previously documented retear (2 traumatic) with revision surgery after a mean of 12 months (range, 2-26 months). Of the other 9 patients, 6 were living abroad, 2 were living in a nursing home (advanced dementia), and 1 refused to attend the follow-up visit. The remaining 46 shoulders could be personally examined after a mean follow-up of 46 months (range, 24-82 months; SD, 13 months). For 37 of these 46 shoulders, the preoperative Constant-Murley score (CS) and American Shoulder and Elbow Surgeons (ASES) score on the standardized form for shoulder assessment, as well as magnetic resonance arthrography, were available for retrospective analysis; preoperative magnetic resonance imaging (MRI) was not available for 5 shoulders, and the preoperative CS or ASES score was not available for 4.

Table I Reasons for wheelchair dependence

Reason	n
Spinal cord injury	44
Poliomyelitis	3
Tumor	2
Ischemic	2
Amputation	1
Spina bifida	1
Iatrogenic after spinal anesthesia	1
Syringomyelia	1
Cerebral palsy	1

Clinical outcome analysis was performed by 2 investigators (K.W. and P.B.) different from the single surgeon who had carried out all the procedures. The CS (which ranges from 0 to 100 points, with 100 points being the best score), the Subjective Shoulder Value (SSV) (which ranges from 0% to 100%, with 100% being the best score), and the ASES score on the standardized form for shoulder assessment (which ranges from 0 to 100 points, with 100 points being the best score) were used. Patients were further asked to categorize their subjective outcome and satisfaction with the surgical result as poor, fair, good, or very good.

The integrity of the repair was analyzed by ultrasound performed by an experienced and independent radiologist (C.B.T.) with special training in musculoskeletal radiology. Every tendon of the rotator cuff was examined and categorized as (1) being intact, (2) having a partial articular- or bursal-sided lesion, or (3) having a full-thickness lesion.

Surgical technique and postoperative care

The first author (J.K.) performed all procedures arthroscopically with the patient in the beach-chair position under general hypotensive anesthesia. The number of fixation points for screw-in anchors was determined according to tear size and tendon retraction. In case of supraspinatus (SSP) and infraspinatus (ISP) involvement with increased tension on the repair, an abduction splint was worn for 6 weeks postoperatively (n = 14). Otherwise, the shoulders were protected using a sling (n = 47). All patients were hospitalized for about 10 weeks in a center for paraplegic patients, focusing on holistic rehabilitation and comprehensive care for wheelchair-dependent patients. The postoperative rehabilitation protocol included use of an electronic wheelchair and strictly passive exercises under the supervision of a physical