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ORTHOPAEDIC SURGERY

Glenoid morphology affects the incidence of radiolucent lines around cemented pegged polyethylene glenoid components

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Abstract
Purpose Radiolucent lines (RLL) are frequent findings around cemented all-polyethylene glenoid implants. The present study evaluates the frequency, extend and the clinical impact of RLL around a cemented two-pegged glenoid implant with special focus on the influence of preoperative glenoid morphology. Our hypothesis was that glenoid morphology does not affect clinical outcome and RLL in the investigated setting.
Methods Between 2003 and 2008, a total of 113 cases of total shoulder arthroplasties (Affinis, Mathys Ltd Bettlach, Switzerland) were performed in three surgical centres using a pegged cemented polyethylene glenoid component. A total of 90 cases could be evaluated clinically and radiographically. Clinical outcome was analysed using the constant score (CS) and range of motion assessment. Radiographic evaluation was performed in true anterior–posterior and axial views with special focus on loosening and RLL. Further, preoperative glenoid morphology was documented and its correlation to radiolucent lines and clinical outcomes was evaluated.
Results At a mean of 58.8 (range 31.2–92.5)-month follow-up the CS improved from 21.5 points preoperatively to 62.3 points postoperatively. Radiolucent lines were found in 76.6 % of cases. If present, RLL were located at the backside of the implant (74.4 %) in the majority of the cases not around the pegs (10 %). There was no significant correlation between RLL and clinical outcome or follow-up time. The amount and extend of RLL were correlated to glenoid morphology with significantly higher values for glenoid types B2 and C according to Walch in comparison to glenoid types A1, A2 and B1.
Conclusions RLL did not affect clinical outcome and did not correlate with the follow-up time. Patients with glenoid morphology types B2 and C showed significantly worse radiographic results.
Level of evidence Level IV case series study.

Keywords Radiolucent lines · Glenoid · Shoulder osteoarthritis · Total shoulder arthroplasty

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Introduction

Cemented all-polyethylene glenoid components have been used in total shoulder arthroplasty since Charles Neer has invented them in the 1970s. So far, this type of glenoid design has been reported to be a more reliable option in comparison to a metal backed glenoid component [1–5]. Different design features have been invented and evaluated since then. A curved-back design has been shown to have less loosening potential than flat-backed components [6, 7]. Pegged glenoid components have been reported to have less tensile edge displacement and to show less radiolucencies

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in comparison to the keeled glenoid design [6, 8, 9]. However, no clear difference has been shown in clinical outcome of keeled or pegged all-polyethylene glenoids.

Radiolucent lines (RLL) have been found to a high extend in cemented glenoid components [8, 10–13] and have been suspected to be progressive, associated with poor clinical outcomes and prone to clinical loosening [13–17]. Erosion of the glenoid, often found in patients with osteoarthritis, has been a major challenge to a successful total shoulder arthroplasty. Walch et al. [18] described three main morphologies of different erosion types of the glenoid in osteoarthritis. In case of signs of eccentric erosion as in type B2 and C glenoid components, these wear patterns may be of clinical impact, since associated static posterior subluxation and biconcave glenoid wear have a risk of eccentric polyethylene wear and early loosening due to a posterior rocking horse effect [18, 19]. Morphologic properties of the glenoid have been suspected also in biomechanical studies to be important factors for implant loosening [20]. There is a lack of data in the current literature evaluating the importance of preoperative glenoid morphology with regard to radiolucencies around a pegged glenoid component.

In this study, we evaluated a patient cohort after implantation of a cemented, two-pegged, convex-back, polyethylene glenoid component. Our hypothesis was that glenoid morphology does not affect clinical outcome and RLL. Therefore, the frequency, extend and the clinical impact of RLL around a cemented two-pegged glenoid implant were evaluated with special focus on determination whether glenoid morphology affects clinical outcomes and radiographic changes around the glenoid component.

Materials and methods

Patient cohort

Between July 2003 and October 2008, 107 patients have been treated in three participating centres with total shoulder arthroplasty using all-polyethylene cemented two-pegged design glenoid component. Six of these patients underwent a bilateral arthroplasty, resulting in 113 implanted glenoid components.

Indications for implantation included advanced osteoarthritis of the glenohumeral joint with severe pain and functional limitation refractory to conservative treatment.

Ten cases were lost to follow-up because they moved, refused to participate in the study or due to their poor medical health condition.

Four cases had to be excluded from final follow-up due to complications leading to revision surgery involving the glenoid component.

Another two cases were excluded because the preoperative constant score was not available. This resulted in a cohort of 93 patients with a minimum follow-up of 24 months. Since four patients (three female and one male) received bilateral arthroplasty, the total number of implanted glenoid components included in this study was $n = 97$ (85.8 %) (25 male, 72 female). These cases are considered as the study population and are set to 100 % in the following. 59 components were implanted into the right shoulder, and 38 into the left shoulder. Among those, 88 components were implanted at the dominant side. At the time of surgery, the mean patient's age was 66.6 years (range 30–85 years).

The diagnosis was primary osteoarthritis in 56 cases (57.7 %) and secondary osteoarthritis in 41 cases (42.3 %). The patient cohort with secondary osteoarthritis included 13 cases (13.4 %) with post-traumatic osteoarthritis, 9 cases (9.3 %) with instability arthropathy, 7 cases (7.2 %) with rheumatoid arthritis, 6 cases (6.2 %) with secondary arthritis due to avascular humeral head necrosis and 2 cases (2.1 %) with multiple epiphyseal dysplasia and chondromatosis and in one case (1.0 %) secondary osteoarthritis due to infection arthritis.

Surgical technique

We used the Affinis shoulder prosthesis (Mathys Ltd Bettlach, Switzerland) with a polyethylene, two-pegged, curved-back, cemented glenoid component. A standardized deltopectoral approach was used. The subscapularis muscle was either tenotomized or a minor tuberosity osteotomy was performed depending on the preference of the operating surgeon. The long head of the biceps was tenotomized and the proximal humerus was exposed. Resection of the humeral head was carried out using the manufacturer's humeral head resection device. A periglenoidal capsular release and release of the subscapularis tendon were performed. A guide pin was positioned using the manufacturer's alignment device. The glenoid surface was prepared by reaming with a cannulated reamer over the pin. Based on the preoperative imaging, glenoid version was corrected by correcting the angle of the alignment device for positioning of the guide pin and consecutive eccentric reaming of the glenoid. The reaming of the glenoid was performed until subchondral bone was exposed and the shape of the glenoid was congruent to the back surface of the glenoid component. Peg holes were drilled and blood and debris were carefully washed out using saline lavage with a syringe. A sponge was pressurised in the peg holes in order to keep them dry and clean and was taken out just before cementing. Retrograde filling of the peg holes with bone cement was performed using a syringe, which fits in the holes. In addition, cement was placed with the syringe around the

pegs on the posterior surface of the glenoid component. Then the two-pegged polyethylene glenoid component was pressurised into the prepared glenoid using an impactor. Pressure was kept on the glenoid component manually until the cement was hardened. After standard preparation of the humeral shaft according to the manufacturer's instructions, humeral head diameter and offset were assessed in situ and the humeral shaft was either cemented ($n = 67$) or press fit ($n = 30$) implanted depending on the bone quality. The subscapularis tenotomy or tuberosity osteotomy was repaired using non-absorbable sutures. Rehabilitation program started on the first postoperative day with passive exercises. After 6–8 weeks, active rehabilitation was started.

Follow-up and clinical evaluation

Patients were postoperatively clinically and radiographically evaluated at a minimum of 24 months with a mean follow-up of 58.8 (range 31.2–92.5) months. A total of $n = 41$ patients (42.3 %) had a follow-up of at least 5 years. All patients were evaluated preoperatively and at final follow-up using the Constant Score (CS) (Table 7) [21]. Strength was measured at 90° of abduction in the scapular plane. If a patient could not reach 90° of abduction, the strength category of the score was set to zero. Ranges of active movement were recorded for forward flexion and abduction in the scapular plane and external and internal rotation. Results were expressed as absolute values and in relation to an age- and gender-adapted score values (agCS) [22].

Radiographic analysis

X-rays were taken in true anterior–posterior (AP) and axial views pre- and postoperatively. A radiopaque marker was used for calibration for further analysis. X-rays and preoperative CT scans, which were performed when glenoid evaluation was not possible in axial X-rays, were evaluated for glenoid morphology and erosion type and classified according to Walch et al. [18]. A CT scan evaluation was present in 49 % of the cases.

The influence of the glenoid type on the clinical and radiographical results was evaluated. Moreover glenoid types were categorised according to the necessity of correcting glenoid version with reaming: Glenoid types A1, A2 and B1 were grouped together as group G1 and comparison was made to B2 and C glenoids, grouped as group G2, which are considered to need bony correction by more aggressive reaming. Due to poor quality of preoperative imaging in three cases, classification was not possible and they were excluded from further analysis.

Final follow-up X-rays were evaluated with special focus on periprosthetic radiolucencies around the glenoid component.

Radiolucent lines around the glenoid were graded by zones and measured for width and scored according to Lazarus (Table 8) and Molé (Table 9) [8, 23]. The Molé radiolucent lines (RLL) score was adapted to the used two-pegged design. Since the score evaluates only RLL on AP X-rays, we added measurement of RLL in axial radiographs. In the true AP and axial X-rays seven zones were defined. Zones 1–5 were evaluated on AP X-rays. Zone 1 was defined as the area under the superior part of the glenoid baseplate, zone 3 as the area under the baseplate in between the two pegs and zone 5 was classified as the area under the inferior baseplate. Zone 2 and 4 were defined as the areas around the superior and inferior peg. In axial X-rays, zone 6 ventral was defined as the area under the ventral or anterior part of the glenoid baseplate and correspondingly zone 6 dorsal as the area under the dorsal or posterior part of the glenoid baseplate. Zone 7 was defined as the area around the two pegs in line in the axial view (Fig. 1).

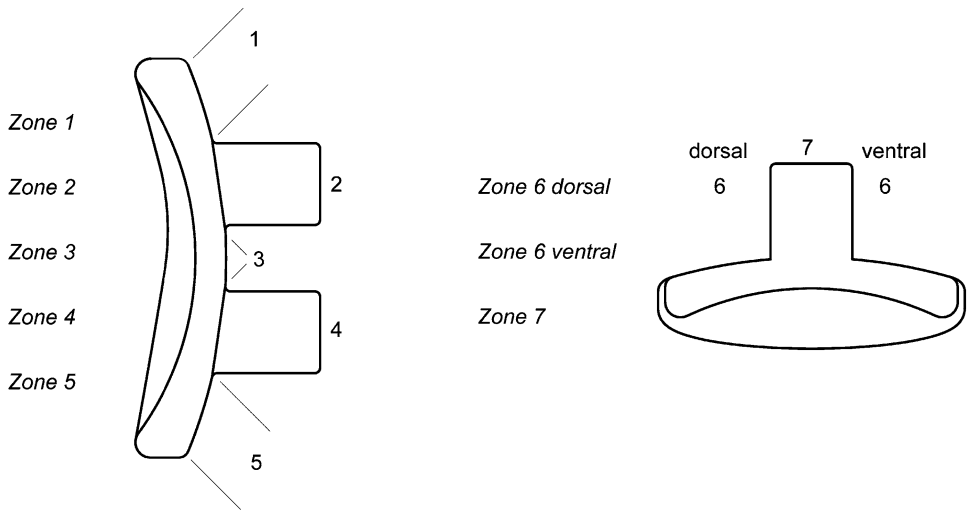

Fig. 1 AP and axillary view of the glenoid component with definition of zones 1–5 on the AP view and zones 6 dorsal, ventral and zone 7 on the axillary view

All radiographs were assessed by a consensus of 3 experienced shoulder surgeons (A. B., S.G., U.I.) to analyse whether RLL are present. If present, the greatest width of radiolucencies in each zone was measured in mm using software measurement system (IMPAX client DS 3000 Agfa, centricity enterprise web V3.0, Chili/Web Software V4.0).

Cases with a score of 6 points or less were classified as having no loosening, a risk for loosening was set with a score of 7–12 points and the component was considered to be loose with a score of more than 13 points according to a previously published study [14].

Statistics

SAS Version 9.3 software (SAS Institute, Cary, NC, U.S.A.) was used for all statistical analyses. The Wilcoxon two Sample test and the Kruskal–Wallis Test were used to test for differences in continuous variables such as scores between group variables (non-parametric tests were used to account for the skewed distribution of the scores). Correlations were tested using Spearman Correlations. To examine associations between categorical variables, the Chi-square test was used. The significance level was set as $p < 0.05$.

Results

Clinical results

The mean CS improved significantly from 21.5 (±9.5) points preoperatively to 62.3 (±17.1) points postoperatively. Also the mean age and gender adjusted agCS improved significantly from 29.0 (±12.7) to 84.2 (±23.3) %. The mean abduction angle improved from 54.3 (±25.4)° to 116.1 (±36.6)° and the mean flexion angle improved from 70.1 (±28.0)° to 129.7 (±39.0)°. The pain related subgroup of the constant score improved from 2.2 (±3.0) points to 12.3 (±3.3) points.

Complications and revisions

We documented ten complications (10.3 %) leading to seven revision interventions (7.2 %). Three complications were managed conservatively: one disturbed wound healing, one patient with postoperative C5/C6 symptoms which resolved 4 months after the operation and one patient with gross loosening and dislocation of the glenoid component who refused to undergo any additional surgical intervention.

Two patients showed postoperative signs of infection (2.0 %), one was superficial and was treated by lavage, the other patient had a deep infection and revision surgery to a reversed shoulder arthroplasty was carried out in a two-step procedure. Three patients showed loosening of the glenoid component (3.0 %) including the above-mentioned patient. The other two cases were revised to hemiarthroplasty. In one case a loose stem had to be revised. One patient showed instability and failure of subscapularis tenotomy and was revised using a pectoralis major transfer. One patient had a secondary reconstruction of a torn supero-posterior rotator cuff. All patients ($n = 5$) in which complications were managed conservatively or revision surgery did not involve the glenoid implants were included in the final follow-up group.

Radiological results

Preoperative evaluation of glenoid morphology and erosion type showed 17 cases with a type A1 glenoid (18.1 %), 24 cases with type A2 (25.5 %), 23 cases with type B1 (24.5 %), 22 cases with type B2 (23.4 %) and 8 cases with type C glenoid (8.5 %). In three cases classification was not possible due to poor image quality and they were excluded from further analysis.

Evaluation of radiolucent lines with the adapted RLL score and the Lazarus score was possible in 90 cases (92.7 %). In 4 cases evaluation was not possible due to insufficient X-ray quality. In general, radiolucent lines were found in $n = 69$ (76.6 %) of the cases. Radiolucencies of more than 1 mm were found in $n = 8$ cases (8.9 %). In the majority of cases with any RLL (Fig. 2), these were located at the backside of the implant (74.4 %) but not around the pegs (10.0 %). The mean RLL score was 2.51 (range 0–24). 89 cases (98.9 %) had a RLL score of <6 and the case described earlier with gross loosening and shifting of the component was classified a score of 24 points (2 points in each evaluated zone).

The distribution of the radiolucencies in relation to the evaluated area is shown in Table 1. Evaluation of postoperative X-rays with the grading scale for radiolucencies according to Lazarus is shown in Table 2. Since the majority of observed radiolucencies were not located around the pegs, the majority (73.3 %) of the investigated components were classified 0 according to Lazarus.

Correlation of radiographical and clinical results

There were no statistical differences between the pre- and postoperative CS between the different types of glenoid according to Walch. Also comparison of group G1 (A1-B1) and group 2 (B2, C) showed no significant differences in the pre- and postoperative CS.

There was no significant correlation between CS and RLL score. Comparing the CS of patients with any radiolucent lines at the glenoid ≤1 mm with patients with any

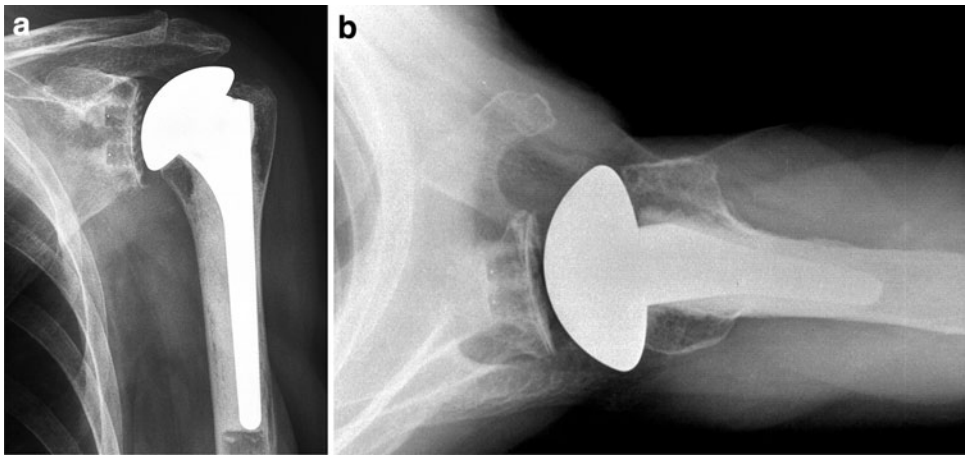

Fig. 2 True AP (**a**) and axial (**b**) X-rays of a 70-year-old female 3 years postoperatively showing RLL behind the backside of the glenoid implant but no radiolucencies around the pegs

Table 1 Mean RLL score by glenoid zones

Glenoid zone	*n* RLL	<1.0 mm	1–2 mm	>2 mm	Mean RLL score
1	50 (55.6 %)	33 (36.7 %)	6 (6.7 %)	1 (1.1 %)	0.5
2	86 (95.6 %)	3 (3.3 %)	0 (0 %)	1 (1.1 %)	0.1
3	57 (63.3 %)	28 (31.1 %)	4 (4.4 %)	1 (1.1 %)	0.4
4	87 (96.7 %)	2 (2.2 %)	0 (0 %)	1 (1.1 %)	0.1
5	51 (56.7 %)	31 (34.4 %)	7 (7.8 %)	1 (1.1 %)	0.5
6 dor	54 (60 %)	30 (33.3 %)	5 (5.6 %)	1 (1.1 %)	0.5
6 ven	65 (72.2 %)	21 (23.3 %)	3 (3.3 %)	1 (1.1 %)	0.3
7	85 (94.4 %)	4 (4.4 %)	0 (0 %)	1 (1.1 %)	0.1
Mean					2.51

Table 2 Classification of radiolucencies according to Lazarus

Lazarus grading	Number	Fraction (%)
0	66	73.3
1	21	23.3
2	2	2.2
5	1	1.1
Total	90	100

radiolucent lines of >1 mm showed no significant differences between these groups. Analysing patient age showed no significant differences in between different types of glenoid according to Walch. Also comparison of age between group G1 and G2 did not reveal any significant differences.

There was no significant correlation between the follow-up time and the RLL score. In addition, between patients with a follow-up of more than 5 years ($n = 41$) and patients with a follow-up of 2–5 years ($n = 56$) there were no statistical significant differences in the CS, agCS, RLL >0 mm and RLL Score (Table 3).

Evaluating the presence of any radiolucency in relation to the glenoid type according to Walch showed that type B2

Table 3 Comparison of clinical and radiographical values according to the follow-up time (≤5 years vs. >5 years)

Follow-up	CS (points)	agCS (%)	RLL >0 mm	RLL score
≤5 years	63.6 ± 15.4	87.4 ± 21.2	43 (82.7 %)	2.94 ± 3.465
>5 years	61.0 ± 19.6	81.4 ± 26.7	26 (68.4 %)	1.92 ± 1.889
Total	62.6 ± 17.2	84.9 ± 23.7	69 (76.7 %)	2.51 ± 2.93

Table 4 Association between glenoid lucencies >0 mm and glenoid type according to Walch

Glenoid type	Any lucency >0 mm		
	None	Any	Total
A1	3 (21.4 %)	11 (78.6 %)	14 (15.9 %)
A2	5 (22.7 %)	17 (77.3 %)	22 (25.0 %)
B1	10 (45.5 %)	12 (54.5 %)	22 (25.0 %)
B2	3 (13.6 %)	19 (86.4 %)	22 (25.0 %)
C	0 (0.0 %)	8 (100.0 %)	8 (9.1 %)
Total	21 (23.9 %)	67 (76.1 %)	88 (100.0 %)

(86.4 %) and C (100 %) glenoids had the highest fraction of any lucency (Table 4).

Comparing grouped glenoid types G1 (A1-B1) and G2 (B2, C) showed significant more RLL in the group G2 ($p = 0.028$) (Table 5). Analysing the effect of RLL and the CS more precisely in group G2 (B2, C) showed that there were no statistically significant differences regarding patients with a follow-up of 2–5 years ($n = 18$) and patients with more than 5-year follow-up ($n = 12$) (Table 6).

Discussion

Despite improved implant designs and longevity, glenoid component loosening remains the most frequent

Table 5 Comparison of RLL of glenoid morphology groups G1 (A1, A2, B1) and G2 (B2, C)

Glenoid type group	Any lucency >0 mm		
	None	Any	Total
G1	18 (31.0 %)	40 (69.0 %)	58 (65.9 %)
G2	3 (10.0 %)	27 (90.0 %)	30 (34.1 %)
Total	21 (23.9 %)	67 (76.1 %)	88 (100.0 %)

Table 6 Comparison of clinical and radiological results of patients of group G2 (type B2 and C glenoid according to Walch) according to the follow-up time of up to 5 years and more than 5 years

Follow-up group G2	CS (points)	agCS (%)	RLL >0 mm	RLL score
≤5 years	64.0 ± 13.7	86.4 ± 20.5	18 (100 %)	4.33 ± 5.1
>5 years	56.5 ± 23.2	70.2 ± 28.6	9 (75 %)	2.50 ± 2.2
Total	61.0 ± 18.1	79.9 ± 24.9	30 (100 %)	3.6 ± 4.3

complication and reason for revision surgery after total shoulder arthroplasty [12, 24–26].

Radiolucent lines have been frequently described after implantation of all cemented polyethylene glenoid components [8] and they have been reported to be progressive and prone to radiographical and clinical loosening [14]. Cementing technique and implant design have been identified to influence the incidence of RLL. [6, 8, 9, 27–29].

This is the first study evaluating the clinical and radiographical performance of a cemented curved-back, two-pegged all-polyethylene glenoid component with respect to the influence of preoperative glenoid morphology on the development of RLL.

Results of the present study show excellent clinical results with a mean gain of around 40 points in the constant score postoperatively. Radiolucent lines were found in a high percentage of all evaluated implants, but did not alter the clinical results.

This confirms the results of previous studies that reported the functional and radiographic outcome after cemented all-polyethylene glenoid components [1, 12, 14, 15]. Favourable clinical results have been shown consistently despite a high percentage of radiolucent lines or even radiographic loosening.

The majority of radiolucent lines were located behind the baseplate of the glenoid component and not around the pegs. This explains the fact that despite the high amount of radiolucencies, the average Lazarus score was very low in the evaluated group.

It remains unclear whether RLL around the baseplate and around the pegs have to be considered equally worrisome with respect to later progression and possible loosening. Regarding the mid-term results, the Lazarus score may represent a reliable score regarding the clinical importance of the RLL, since it considers only radiolucencies around the pegs. However, the Lazarus score may underestimate the value of RLL with respect to a possible later progression of RLL at the back of the glenoid baseplate into the area of the pegs and the risk loosening.

In the present study, the glenoid morphology did not have any influence on the pre- or postoperative score results. Moreover, in between the different groups of glenoid morphology there was no significant difference regarding RLL. However, the amount of RLL was significantly higher when comparing grouped patients with B2 and C glenoids according to Walch [18] with A and B1.

This finding is of clinical relevance since it shows that patients with more severe glenoid wear may be prone to implant loosening and it confirms clinical experience that glenoid components can be implanted more reliable in A1, A2 and B1 glenoids in comparison to B2 and C glenoids. Other authors have reported about an association of cases with glenoid erosion and increased glenoid component migration [30, 31]. One explanation could be that bony correction by reaming, as it is necessary in B2 and C glenoids, may be associated with poor fixation and seating of the component due to weakening of the bone and may, therefore, lead to RLL. Walch et al. [14] showed a 21 % rate of radiographic loosening after 5 years following excessive reaming of the glenoid bone. Another explanation may be that due to posterior humeral subluxation in these morphology types, there is an eccentric loading on the glenoid component [32]. This holds especially true since Boileau et al. [2] showed that recurrence of posterior subluxation of the humeral head after implantation of a total shoulder arthroplasty is frequent despite correction of glenoid version. Wirth et al. [33] showed with a partially cemented pegged polyethylene glenoid that best results in terms of component seating and radiolucent lines are achieved in A1 glenoids. Gerber et al. [19] showed that re-centering of posterior humeral subluxation is not correlated to the correction of glenoid version. In our study, subluxation of the humeral head and the correction of glenoid version postoperatively have not been evaluated. However, the present findings indicate that preoperative glenoid morphology and associated biomechanical changes in B2 and C glenoids may be responsible for the higher amount of radiolucencies in these cases. Therefore, we can only partly accept our hypothesis: glenoid morphology showed no influence on clinical outcome when comparing each type of glenoid morphology type. However, grouping the patients according to the necessity of bony correction with more aggressive reaming showed a significant difference in between these groups.

This study has several limitations. First, as mentioned above, we did not perform postoperative CT scan

Table 7 Constant-Murley score [21]

		Range of motion (40 points)	
Flexion		External rotation (10 points)	
0°–30°	0	Hand behind head with elbow held forward	2
31°–60°	2	Hand behind head with elbow held back	2
61°–90°	4	Hand on top of head with elbow held forward	2
91°–120°	6	Hand on top of head with elbow held back	2
121°–150°	8	Full elevation from on top of head	2
151°–180°	10		
Lateral elevation		Internal rotation	
0°–30°	0	Dorsum of hand to lateral thigh	0
31°–60°	2	Dorsum of hand to buttock	2
61°–90°	4	Dorsum of hand to lumbosacral junction	4
91°–120°	6	Dorsum of hand to waist (3rd lumbar vertebra)	6
121°–150°	8	Dorsum of hand to 12th dorsal vertebra	8
151°–180°	10	Dorsum of hand to interscapular region (DV 7)	10
		Total maximum	40
Pain (15 points)		**Activities of daily living (20 points)**	
None	15	Full work	4
Mild	10	Full recreation/sport	4
Moderate	5	Unaffected sleep	2
Severe	0		
Power (25 points)		Arm positioning:	
0–1 kg	1	Above head	10
2–3 kg	5	Up to top of head	8
4–5 kg	9	Up to neck	6
6–7 kg	13	Up to xiphoid	4
8–9 kg	17	Up to waist	2
10–11 kg	21		
12 kg and more	25	**Total maximum**	20

Table 8 Lazarus Score [8]

Grading scale for radiolucencies about pegged glenoid components	
Grade	Finding
0	No radiolucency
1	Incomplete radiolucency around one or two pegs
2	Complete radiolucency (≤2 mm wide) around one peg only, with or without incomplete radiolucency around one other peg
3	Complete radiolucency (≤2 mm wide) around two or more pegs
4	Complete radiolucency (≥2 mm wide) around two or more pegs
5	Gross loosening

Table 9 Modified RLL score according to Molé [23]

Zones/points	<1 mm (1 point)	1–2 mm (2 points)	>2 mm (3 points)	RLL score (max. 24 points)
1				
2				
3				
4				
5				
6 ventral				
6 dorsal				
7				

evaluation of the shoulders in order to measure correction of glenoid version and remaining posterior humeral head subluxation. Therefore, we cannot comment whether the higher amount of RLL in B2 and C glenoids may also be associated to a higher degree of remaining retroversion and/or posterior subluxation of the humeral head. Moreover, a postoperative CT scan evaluation would have strengthened the evaluation of RLL. Second, we did not evaluate for RLL at different time points and therefore, are not able to comment whether they have been progressive in the evaluated time frame. However, we did not find any correlation of the presence of RLL and the follow-up time and patients with a follow-up of 5 years and more did not

have more radiolucent lines than patients with a follow-up of 2–5 years. Therefore, we expect RLL to be relatively stable in the evaluated time period.

Conclusion

Radiolucent lines around a cemented, pegged, all-polyethylene glenoid component are frequent behind the baseplate but rarely involve the pegs. B2 and C glenoids are associated with a higher rate of RLL and may therefore be more prone to later loosening. Whether this is due to a lack of correction of glenoidal version, glenoid preparation or persistent humeral head subluxation needs to be evaluated in the future.

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