Failure of Capsular Enhanced Short External Rotator Repair After Total Hip Replacement

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Abstract: The failure rate of repaired short external rotator muscles was determined in 20 total hip replacements done in 19 patients. The piriformis, both obturator and gemellus muscles, and the capsule were released close to the femur in a single flap leaving the tendon-capsule junction intact. After implantation of the prosthetic components, the flap was transosseously reattached with three grasping stitches, each encompassing the entire tendon-capsule junction. Radiopaque markers were attached to each side of the suture. The distance between markers was measured intraoperatively and then determined on radiographs 1 day and 3 months postoperatively; 25 mm or more and at least double the distance measured intraoperatively indicated failure. In 15 of the 20 hips the repair failed; in three hips the repaired flap was pulled out within the first day, and in 12, within 3 months. Capsular enhanced repairs of the short extensor rotator muscles, using the technique described, largely are unable to withstand forces that occur at the site of repair during the healing process. The quality of other repair techniques should be determined to identify superior techniques.

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There are numerous advantages of the posterior approach in primary total hip replacement, making it the most popular approach in use.[7,20] A concern, however, is the risk of dislocation.[13] Numerous studies have examined the benefit of short external rotator muscle and capsule repair to prevent dislocation. In several clinical studies a lower dislocation rate was found in patient series where these soft tissues were repaired, compared with series where they were either not repaired[10,14,15,20] or minimally[2,14] repaired. Nonetheless, an unusually high dislocation rate of 9.5% was reported despite repair of the piriformis tendon and both obturator tendons.[18]

Various short external rotator tendon to bone repair techniques have been described. All of them aim to restore the integrity of the interrupted soft tissues to achieve joint stability. However, the quality of the interrupted tendon tissues often does not allow good stitch anchorage, and the force produced by the repaired muscle units during rehabilitation barely can be controlled with a postoperative regimen, both of which compromise the success rate of the repair.

Little information is available on the quality and failure rates of the different repair techniques, making the choice of a particular technique mainly a matter of personal preference. In a cadaver model, transosseous suture anchorage of a tendon-capsule flap provided superior stability compared with repair with suture anchorage in tendon tissues only.[16] In two clinical studies, short external rotators were reinserted with transosseous suture anchorage but without capsule suture, and radiopaque reference points were attached to each side of the repair; early postoperative radiographs showed significant dehiscence indicating repair failure in 80%[8] and 70% of the repairs.[17]

To optimize stitch anchorage some surgeons[2,7,12,16,20] take advantage of the fact that the posterior joint capsule is firm and in junction with the short external rotator muscles close to their insertion. They use an approach that does not separate the tendon-capsule junction and a stitch that encompasses the entire junction.

The aim of the current study was to determine the failure rate of short external rotator muscle repair with such a capsular enhancement.

MATERIALS AND METHODS

Twenty total hip replacements were done by the senior author (UM) on 19 patients (8 women, 11 men). The mean age at the time of surgery was 66 years (range, 55–81 years). None of the patients had rheumatoid arthritis, neuromuscular disorders, or dysplastic proximal femur, and none had previous surgery on the hip examined in this study. Written informed consent to participate in the study was obtained from all patients.

The posterior approach to the hip[11] was used. The quadratus femoris muscle was partially released. The piriformis tendon was cut close to the bone. Because the cut could not be made at its end at the anterior part of the major trochanter, a remnant of the tendon had to be left in the sulcus piriformis, which usually weakened the junction with the capsule. The

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tendons of both obturator and both gemellus muscles—these bandlike structures are the so-called conjoined tendons—and the posterior capsule were released close to the bone in a single cut. The junction of the capsule with the piriformis and the conjoined tendon was preserved. The posterior capsule then was incised proximal to and in the direction of the piriformis tendon and distal to and in the direction of the conjoined tendon to form a single tendon-capsule flap.

The prosthetic components were implanted (FITMORE cup and CLS shaft, Zimmer, Winterthur, Switzerland), and joint stability was confirmed.

The tendon-capsule flap was reattached in all patients with three modified grasping stitches[9] each of which incorporated the entire tendon-capsule junction. The first stitch was applied to the tendon-capsule junction of the piriformis tendon using TICRON® USP Number 5 (Tyco, Gosport, England). The second and third stitches were applied to the tendon-capsule junction of the conjoined tendon using TICRON® USP-number 5 and VICRYL® USP Number 2 (Ethicon, Norderstedt, Germany). For transosseous suture fixation, 2-mm holes were drilled in the posterior aspect of the greater trochanter.

The technique to mark both sides of the suture has been described previously.[17] A thin wire was stitched to the piriformis tendon and a second one to the conjoined tendon. The wires were located adjacent to the stitches. On the femoral side a tantalum ball was attached to the greater trochanter at the reinsertion point. Knotting TICRON® and VICRYL® was done in approximately 10° internal rotation and 45° flexion after which the amount of internal rotation was measured at the point where resistance was noticed. The mean internal rotation was 12.5° (range, 5°–12°).[4] All of the 20 repairs were intact. The distance between the two opposing reference points at the piriformis tendon and the conjoined tendon then was measured intraoperatively.

The postoperative regimen included walking on crutches with full weight bearing being allowed on the first postoperative day, a maximum hip flexion of 70°, and no internal rotation for 2 months during which time Coumadin (Roche, Reinach, Switzerland) was administered.

Axial and anteroposterior (AP) radiographs of the hip[21] were done on the first postoperative day and 3 months after the operation. On the radiograph the distance between the wire knot and the tantalum ball was measured. As previously de-

TABLE 1. Radiographic Distances Between Reference Points (in mm) on Short External Rotator Muscles After Enhanced Repair in 20 Total Hip Replacements

Patient Number/Side	Intraoperatively		First Postoperative Day				3 Months Postoperatively			
			Piriformis		Conjoined Tendon		Piriformis		Conjoined Tendon	
	Piriformis	Conjoined Tendon	AP	Axial	AP	Axial	AP	Axial	AP	Axial
1/Left	10	10	12	3	—	13	24	13	20	23
2/Left	5	12	7	1	1	12	22	3	13	12
3/Left	10	7	10	7	—	11	25	27	—	22
4/Left	10	12	20	15	20	15	30	28	30	32
5/Right	5	10	11	9	13	3	18	12	20	6
6/Right	12	8	13	11	14	13	37	14	45	9
7/Right	10	13	17	—	16	—	25	25	35	22
7/Left	12	12	18	—	13	—	30	27	27	16
8/Left	10	12	20	20	25	31	25	25	25	34
9/Right	12	12	15	—	11	—	21	15	13	—
10/Right	11	13	—	7	—	15	25	7	—	19
11/Right	15	10	25	15	—	15	40	22	40	20
12/Left	15	15	35	33	—	16	40	22	—	43
13/Right	20	15	31	30	13	15	60	40	53	20
14/Left	10	15	22	15	25	15	27	—	30	—
15/Left	10	10	35	—	23	—	35	33	28	23
16/Right	15	13	21	24	—	14	42	—	—	13
17/Right	15	12	19	19	16	18	30	—	24	—
18/Left	12	14	—	14	—	5	26	19	—	5
19/Left	15	20	11	8	27	11	26	—	33	—

— = no data available.

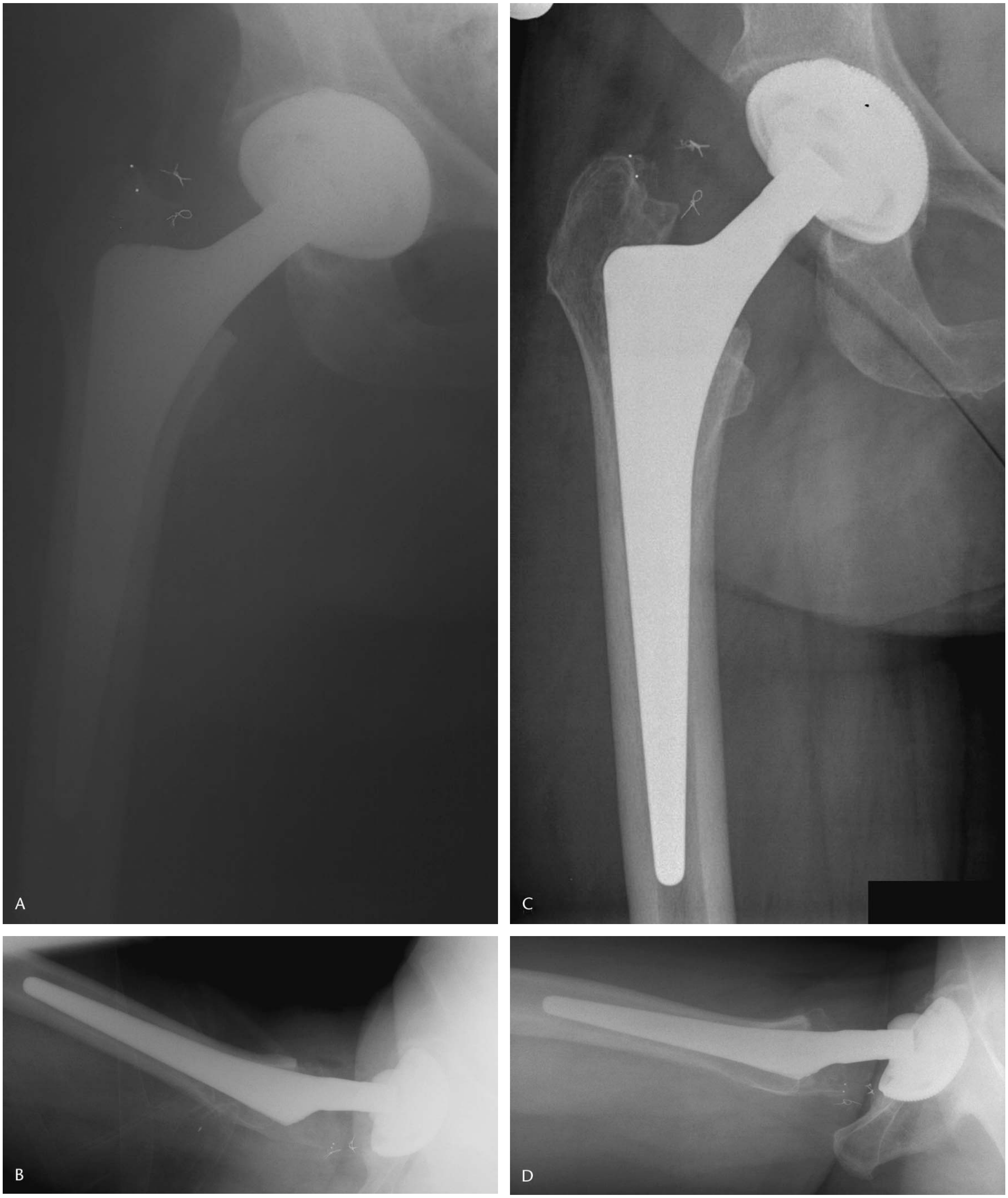

FIGURE 1. A, The AP radiograph on the first postoperative day shows reference points on each side of the enhanced repair of the piriformis tendon and the conjoined tendon less than 25 mm apart. B, As in A, no failure of the capsular reinforced short external rotator muscle repair is seen in the axial radiograph on the first postoperative day. C, The AP radiograph 3 months postoperatively shows a similar scenario as seen in the AP radiograph on the first postoperative day. D, The axial radiograph 3 months postoperatively shows a similar scenario as seen in the axial radiograph on the first postoperative day.

fined,[8,17] a distance between reference points of 25 mm or more in any radiograph and at least double the distance measured intraoperatively indicated failure.

RESULTS

In 15 of the 20 hips (75%) the capsular enhanced repair of the short external rotator muscles after total hip replacement failed (Table 1). In 10 of the 20 hips the capsular enhanced repair of the piriformis tendon and the conjoined tendon failed, and in five only the capsular-enhanced repair of the piriformis tendon failed. In the remaining five hips, no failure was observed (Fig. 1).

Of the 15 failed repairs, three hips already showed significant dehiscence (failure) on the radiographs done on the

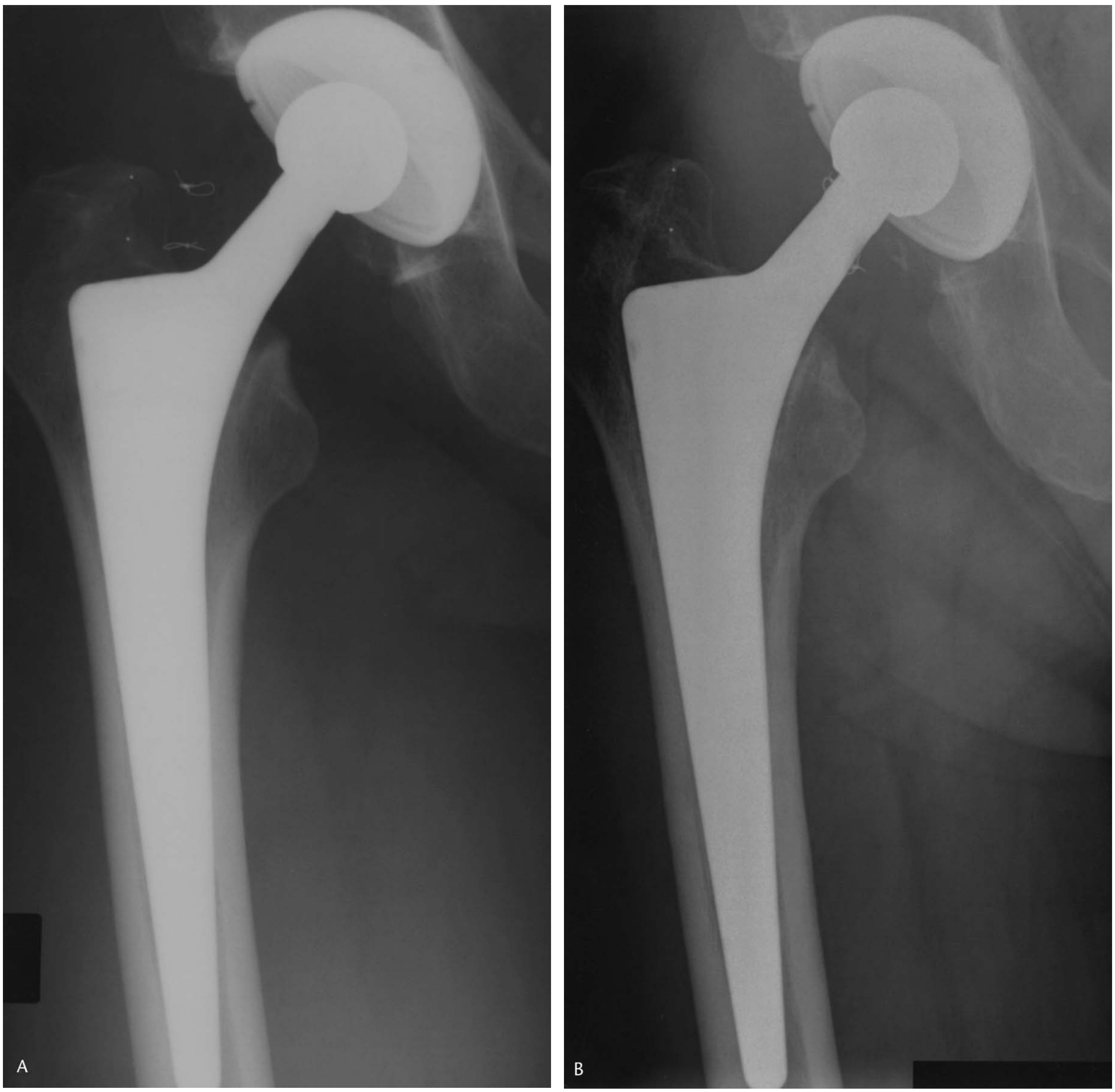

FIGURE 2. A, Although reference points are close to each other in the AP radiograph on the first postoperative day (piriformis tendon 13 mm; conjoined tendon 14 mm), (B) the distance between them increased dramatically in the radiographs 3 months postoperatively (piriformis tendon 37 mm; conjoined tendon 45 mm).

first day postoperatively, whereas the other 12 hips did not show any indication of failure until the radiographs obtained 3 months postoperatively (Fig. 2).

DISCUSSION

Numerous techniques describing the posterior approach to the hip recommend that the short external rotator muscles be released from the greater trochanter and from the posterior joint capsule, and that the muscles and the capsule then be repaired separately.[1,3,6,10,14,19] A capsule repair in addition to the muscle repair may provide a scaffold promoting capsular healing within a short time. It also may promote tendon healing by protecting new cells at the tendon repair from being flushed away during joint fluid movements. From a biomechanical point of view, however, the separate capsule repair does not enhance the early postoperative pull-out-strength of the short external rotator muscle repair, which has been shown to be insufficient.[8,17]

The pull-out-strength is determined by the weakest point in the surgical repaired structures. Given the fact, that in transosseous muscle repair, thick nonabsorbable suture material is used and the cortex at the trochanter is usually hard, one might assume that the weakest point would be the stitch anchorage in the tendon tissue. This notion is supported by the following: the tissue quality of short external rotator muscles makes a strong stitch anchorage hard to achieve; insufficient stitch anchorage with slipping of the stitch through the tendon is the most frequent finding in failed transosseous infraspinatus tendon repair in sheep, even when a superior stitch technique is used[5]; and with the postoperative regimen there is limited potential to control hip muscle force while the repaired tendons are healing. It would therefore seem logical that an enhancement of this weak point would be effective in the reduction of repair failure.

The piriformis muscle, both obturator muscles, and both gemellus muscles insert not only on the greater trochanter but also on the joint capsule. If the muscles are released close to the bone, the tendon-capsule junction can be preserved (Fig. 3). The firm consistency of the joint capsule and the tendon-capsule tissue complex should allow enhanced stitch anchorage, thereby increasing the pull-out strength of the short external rotator muscle repair. The capsule is firm. A thick and firm tendon-capsule tissue allows enhancement of the stitch anchorage and may therefore be expected to increase the pull-out strength of the short external rotator muscle repair.

To our surprise however, the current study revealed an unacceptably high failure rate of 63% (i.e. 25 of a total of 40 repairs) after capsular enhanced short external rotator muscle repair. This is only marginally lower than the failure rates of 80%[8] and 70%[17] found in previous studies in which techniques without enhancement of the tendon stitch anchorage were used.

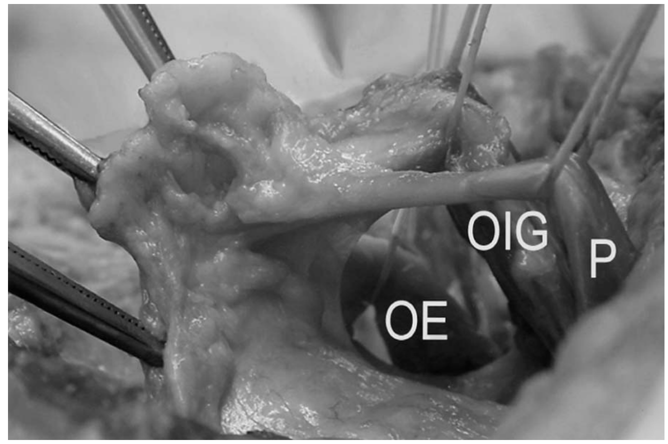

FIGURE 3. The craniocaudal view of the right hip of a cadaveric specimen shows the piriformis (P), the obturator internus with both gemellus muscles (OIG) and the obturator externus muscle (OE) inserting at the posterior joint capsule. The capsule and these short external rotator muscles have been released from the femur. Clamps are clipped to the capsule, and stitches comprise and pull at the muscles (P, OIG, and OE).

The high failure rate of the capsular enhanced repair in this study could be attributed to unnaturally high tension of passive elements caused by early internal rotation, despite the preventative measures taken intraoperatively by the surgeon: to preserve the flap length the tendon-capsule flap was released close to the bone—the stitches in the flap were set no more than 1 cm away from the cut end—and the flap was lengthened by incising the posterior capsule at the acetabulum as done by White et al.[20] Flap reinsertion was done using a technique similar to that described by Sioen et al,[16] who used a technique with which safe internal rotation in the cadaveric specimen greater than 30° was possible. To maintain the length of the flap the sutures were knotted in internal rotation as recommended by White et al.[20]

Two points could not be addressed because of limitations of the study: (1) the exact time of the repair failure could not be determined in the cases where significant dehiscence was seen only on the second postoperative radiographs which gave a substantial interval of 3 months during which the failure could have occurred; (2) the study did not allow determination of the tissue quality of the posterior tendon-capsule flap in repair failure after the healing process had started. With pseudocapsule and tendon scar tissue formation dehisced tendons (failure) still might be in continuity as previously found experimentally.[5] However, this also might be the case when no repair has been done at all.

Capsular enhanced short external rotator muscle repair after total hip replacement is insufficient to reliably withstand the forces that occur in the repair as it is healing. The quality of other repair techniques should be determined to identify superior techniques.

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