

## Clinical results of meniscus repair with the meniscus arrow: a 4- to 8-year follow-up study

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Received: 3 February 2006 / Accepted: 16 March 2006 / Published online: 21 July 2006  
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**Abstract** The short-term clinical results of meniscus repair with the meniscus arrow were promising. Unfavorable outcomes were reported in two studies, with longer follow-up, raising concerns about the efficacy of this device. We retrospectively reviewed 62 patients (mean age 23.7 years; range 14–37 years) that underwent all-inside meniscus repair, using the meniscus arrow. Seventeen patients had an isolated meniscus tear (ACL intact group) and 45 patients concomitant ACL rupture that was reconstructed at the same time with the meniscus repair (ACL reconstructed group). All patients followed a non-aggressive rehabilitation protocol. Follow-up was assessed by clinical examination, Lysholm and Tegner score, IKDC knee examination form and KT-2000 arthrometry for the anteroposterior laxity of the reconstructed knees. At an average follow-up of 73 months (range 49–96 months) there were three failures (4.8%), one from the ACL intact group and two from the ACL reconstructed group. One patient developed arthrofibrosis (ACL reconstructed group) that resolved conservatively. Soft tissue irritation at the repair site was noted

in three patients. In two patients the symptoms were transient. In the third patient the arrow tip was cut off under local anaesthesia due to saphenous infrapatellar branch irritation and the symptoms resolved (inappropriate arrow size). KT-2000 arthrometry showed that sagittal knee laxity was less than 3 mm in all reconstructed knees. The mean Tegner activity score decreased from 6.7 (pretrauma) to 6.2 (postoperatively). The average Lysholm score was 96, with normal or nearly normal function of all success knees, according to the IKDC knee examination form. Our results show a high clinical success rate of meniscus repair with the meniscus arrow. We found this device both safe and effective.

**Keywords** Meniscus repair · Arrow · Results · Complications · Rehabilitation

### Introduction

Many authors have documented the detrimental effect of total and subtotal meniscectomy. Early osteoarthritis and cartilage degeneration of the tibiofemoral joint could be prevented by meniscus preservation [4, 15, 20, 28]. Meniscus repair is universally accepted as the treatment of choice for meniscal tears, whenever possible [6, 11].

Many suture techniques for meniscus repair have been described, including open and arthroscopically-assisted outside-in and inside-out methods. Recently a variety of all-inside repair devices have been developed with the advantage of simplicity of insertion. The fact that there is no need for capsule exposure, with an additional incision, reduces the operating time and the

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risk of neurovascular injury associated with suture techniques. Meniscus arrow (Bionx, Blue Bell, PA, USA) is a biodegradable all-inside device that became very popular due to the above mentioned reasons. It is a T-shaped tack with barbs on the stem, made of polylactid acid and is fully absorbed in the human body, by hydrolysis. Albrecht-Olsen was the promoter of this device and presented [1] the meniscus arrow in 1993.

Despite meniscus arrow is a popular all-inside meniscus repair method there are only a few studies in the literature reporting on the clinical results after its use. Some authors [21, 27, 34] reported favourable clinical outcomes, after meniscus repair with the meniscus arrow, at a follow-up of up to 36 months. However, more recently, Kurzweil et al. [22] reported unsatisfactory clinical results at an average follow-up of 54 months (range 36–70 months), while Lee and Diduch [23] reported increased failure rate with long-term follow-up, using the same device. In both cases the authors stated that the unfavourable results prompted them to abandon the use of meniscus arrow. DeHaven et al. [12], in a more than 10 years study of open meniscus repair, found that failures occur at an average of 4.1 years.

The purpose of this study was to determine the success rate of meniscus repair with the meniscus arrow in patients with more than 4 year follow-up and to compare the results with other published results. The efficacy of this device is also evaluated.

## Materials and methods

Between January 1997 and December 2002, 103 patients underwent meniscus repair in our department. Sixty-seven patients, treated with the meniscus arrow, met the criteria for this study. Inclusion criteria were: (a) unstable in probing, vertical, longitudinal meniscal tears in the red–red or red–white zone, (b) tears 1–4 cm in length, (c) ACL intact or ACL reconstructed knees, (d) intact posterior cruciate ligament, (e) no major cartilage damage (normal cartilage or lesions grade 1 according to ICRS classification) and (f) follow-up more than 4 years. Large bucket-handle tears, more than 4 cm in length, amenable for repair, are treated in our department with the meniscus arrow for the posteromedial or posterolateral horns and 2-0 PDS horizontal sutures (inside-out) for the rest of the lesion (hybrid technique). Those patients were excluded from this study. Nineteen patients had an isolated meniscal tear (ACL intact group) and 48 patients had concomitant ACL deficiency that was reconstructed (ACL

reconstructed group). The reconstruction of the ACL was performed at the same time with the meniscus repair.

All procedures were performed by the same surgeon in keeping with the manufacturer's recommendations (meniscus arrow; Bionx implants) and that described by Albrecht-Olsen et al. [1]. Arrows were inserted manually after rasping and reducing the tear. Special care was taken in the orientation of the arrows, trying to achieve a perpendicular approach to the tear, parallel to the tibiomeniscal surface. Central third bone patella tendon bone (BPTB) autograft was used for ACL reconstruction in 26 patients and semitendinosus/gracilis (ST/G) autograft was used in 22 patients.

The study population consisted of 49 male and 13 female patients. The average patient's age at the time of surgery was 23.7 years (range 14–38 years). Time from suspected injury to repair ranged from 0 to 14 weeks with a mean of 6.4 weeks. There were 55 medial (88.7%) and 7 lateral (11.3%) tears. Thirty-eight tears were located in the red–red zone (61.3%) and 24 in the red–white zone (38.7%). The length of the tear averaged 2.28 cm (range 1–4 cm) and the mean number of arrows, used per meniscus to accomplish the repair, was 3.2 (range 1–7). 8.8% of the arrows implanted were 16 mm in size, 84.8% were 13 mm and 6.4% were 10 mm.

Postoperative management consisted of use of a hinged knee brace with restricted motion from 0° to 90° of flexion for 6 weeks. In the first 2 weeks CPM (continuous passive motion), electrical stimulation of the quadriceps and straight leg lifting exercises initiated to prevent knee stiffness and muscle atrophy. After the fourth week weight bearing was begun as tolerated. The brace was discontinued at 8–10 weeks depended on the muscle strength of the involved leg. Return to athletic activity and squatting were permitted after 4 months for the ACL intact group and 6 months for the ACL reconstructed group.

Five patients were lost in follow-up leaving 62 (92.5%) patients that were reviewed by an independent, qualified examiner (an Orhtopaedic Surgeon not involved in patients treatment). Patient's data were collected from patient's records and notes. Seventeen patients were from the ACL intact group and 45 patients were from the ACL reconstructed group (24 BPTB subgroup, 21 ST/G subgroup).

Follow up was assessed by both subjective and objective means. A comprehensive clinical examination was performed. Joint-line tenderness, Mc Murray's test, effusion and mechanical symptoms (catching, locking, giving way) were specifically recorded to evaluate meniscus healing. Along with the clinical

examination using the Lachman, anterior drawer and pivot-shift tests, anteroposterior instability was measured by KT-2000 arthrometry. Knee function was evaluated by the Lysholm score and the activity level before injury and at follow-up was rated by the Tegner scale. Patients were also evaluated according to IKDC knee examination form and graded as A (normal), B (nearly normal), C (abnormal) and D (severely abnormal).

## Results

Failure was defined as the need of rearthroscopy and partial meniscectomy. There were three failures, making a total failure rate of 4.8%. One patient was from the ACL intact group (failure rate 5.9%) and two patients were from the ACL reconstructed group (failure rate 4.4%). The patient from the ACL intact group was a 37-year-old male, who complained for persistent knee pain and effusion after the sixth month. The initial conservative treatment was not effective and he finally underwent arthroscopic partial meniscectomy 12 months after the meniscus repair. The two failures from the ACL reconstructed group were both in young (18- and 19-year old), male athletes who suffered a new injury 14 and 16 months postoperatively. Pain was the predominant symptom in both patients without sense of instability or clinical findings of anteroposterior laxity. Evaluation under anaesthesia revealed no pathololaxity. The ACL graft was intact at rearthroscopy and a complex meniscal tear was found with the repair site involved. No arrow remnants or cartilage damage were found at rearthroscopy in all three failures.

There were no infections in the patients reviewed. One patient from the ACL reconstructed group, developed arthrofibrosis that resolved with medication and physiotherapy. Soft tissue irritation at the refixation site from the meniscus arrows was observed in three patients (4.8%). In two patients transient pain or tenderness were obtained and symptoms gradually resolved, without any surgical intervention, within 4 months. One patient complained for intermittent local pain and dysesthesia related to knee flexion, due to saphenous infrapatellar branch irritation. He had a medial meniscus tear repaired with two 13-mm and one 16-mm arrows. The arrow tip was cut off under local anaesthesia and the symptoms resolved (inappropriate arrow size). There were no serious neurovascular complications.

At a mean follow-up of 73 months (range 49–96 months), the average pretraumatic Tegner activity

score decreased from 6.7 (range 3–10) to 6.2 (range 3–10) postoperatively and the mean Lysholm score was 96 (range 81–100). There were no mechanical symptoms (catching, locking or giving way), pain or effusion reported. Clinical examination revealed a negative Mc Murray's test and negative joint-line tenderness in all patients, without anteroposterior instability. KT-2000 arthrometry demonstrated that sagittal knee laxity was less than or equal to 3 mm in all reconstructed knees (including the two failures from the ACL group) compared to the healthy side (average 0.82 mm; range –1–3 mm). Of the successful repairs, 41 knees were graded overall as A (normal) and 18 as B (nearly normal) according to the IKDC knee examination form.

## Discussion

Albrecht-Olsen et al. [2] reported on this device in a prospective randomized study comparing the arrow to the inside-out technique with horizontal sutures. They used re-arthroscopy, 3–4 months after the meniscus repair, to evaluate the healing process and they found no statistical differences in healing rates between the two groups. They found three partially healed and three not healed menisci in the arrow group (33 patients). Interestingly failure was suspected in only one of these patients. In the suture group (32 patients), six menisci were partially healed and eight not healed, with only four of these patients having clinical symptoms. Their study showed that menisci can be partially healed or not healed without any clinical symptoms. Tenuta and Arciero [37] reported similar results, indicating that an asymptomatic meniscus repair is not a healed meniscus. Therefore, the high clinical success rate in our study should be distinguished from the healing rate since we did not perform a second-look arthroscopy to verify healing.

The ability to assess meniscal healing is a difficult task. Second-look arthroscopy is nearly impossible to perform in asymptomatic patients 4–8 years postoperatively, due to ethical considerations. Muellner et al. [26] reported that MRI is unsuitable for diagnosis of the healing process of a repaired meniscus and Steenbrugge et al. [36] stated that MR signals at the site of repair represent oedematous scar tissue, not true non-unions. Risk of infection and cost are also remarkable reasons for not using arthroscopy, MRI or arthro CT scan to verify meniscus healing. Therefore we used the absence of clinical symptoms as clinical success, like other authors did, [10, 14, 21–24, 27, 34, 35].

Studies reporting on the short-term clinical results of meniscus repair with the meniscus arrow were encouraging. Spindler et al. [34] reported a success rate of 92% for medial meniscus repairs, at an average follow-up of 27 months. Petsche et al. [27] at a mean follow-up of 24 months (range 12–42 months), found two failures in 29 patients (success rate, 93%), including two repairs in ACL-deficient knees. One of these failures occurred in an ACL-deficient knee. Jones et al. [21], in a 2- to 3-years study (average 29.7 months), reported two failures following 39 meniscus repairs in stable knees. Both failures occurred in displaced bucket-handle tears, one of which was located in the white–white zone of the meniscus. They all stated that further long-term follow-up is required to carefully assess the efficacy of this device.

Two studies [22, 23] with longer follow-up reported unfavourable outcomes, raising concerns about the effectiveness of the meniscus arrow. Kurzweil et al. [22] studied 60 repairs and reported a success rate of 72% (17 failures) at an average follow-up of 54 months (range 36–70 months). Three of the failures occurred in unsuccessful ACL procedures (ACL radiofrequency shrinkage and arthroscopic fixation of a tibial eminence) that left those knees unstable. In the first ten patients they followed an aggressive, braceless rehabilitation programme and they found five failures, three of which were in displaced bucket-handle tears. Later in this study the rehabilitation protocol was slowed and the displaced bucket-handle tears were not repaired exclusively with the meniscus arrow. Lee and Diduch [23] studied 32 patients and they found that a 90.6% success rate at a mean follow-up of 2.3 years deteriorated to 71.4% at 6.6 years (range 65–88 months). From the initial study population 16 tears were acute repairs (range 1.7–6 weeks) and 23 were chronic repairs (range 2–48 months). The rehabilitation protocol in this study consisted of use of a hinged long leg brace for 2 weeks postoperatively. Patients were permitted immediate crutch-assisted weightbearing and range of motion as tolerated.

The higher success rate in our study compared to the previous ones could be explained by the slower rehabilitation protocol, the chronicity of the tear and the fact that large tears more than 4 cm in length were excluded from our study.

Rehabilitation after meniscus repair is still controversial in the literature. Some authors [5, 24, 32] advocated that an accelerated protocol with immediate, unrestricted range of motion and full weightbearing, does not compromise the final outcome. Others [2, 19, 21, 27] have recommended a less aggressive postoperative program with limited motion and

weightbearing. An initial period of no weightbearing is also recommended by the manufacturer (Bionx implants) to prevent fracture of the meniscus arrow. Biomechanical studies [7, 8, 29] have demonstrated that pull-out strength and linear stiffness (ability to resist deformation) of the arrow are inferior to both vertical and horizontal sutures, potentially signifying that aggressive rehabilitation protocols are contraindicated when using this device.

Many authors [10, 13, 14, 18] reported on the effect of chronicity in healing rates, with acute tears having superior results than chronic tears. Although someone might assume that chronic tears are more likely to be degenerative, we agree with Belzer and Cannon [6] that increased time from injury to operation should not discourage the surgeon from performing repair in amenable meniscus tears.

It has been reported [6, 10] that meniscus healing is inversely related to tear length. Large tears, more than 4 cm in length, are treated in our department with the hybrid technique, due to concerns of the biomechanical properties of the meniscus arrow. Therefore, this study cannot provide any information for this kind of tears.

Our results are comparable with those of Steenbrugge et al. [35] who reported 22 good and excellent results in 25 repairs at an average follow-up of 6 years, with one failure occurring in a white–white meniscus tear. The rehabilitation protocol used in this study was similar to ours.

Several complications with the meniscus arrow have been reported including chondral injury [3, 31], arrow migration [16], foreign body reaction [25], synovitis [33], breakage of the arrow [9], transient pain [38] due to local irritation from the tip of the arrow and cystic formation [17]. Most of the complications reported in the literature were transient probably because of the absorption of the implant. In our study there was a low rate of complications but we did not assess chondral injury that could be verified by second-look arthroscopy.

## Conclusions

Our study shows a high clinical success rate of meniscus repair with the meniscus arrow. A non-aggressive rehabilitation protocol is maybe preferred when using this device, since its biomechanical properties are inferior to sutures. The numerous complications reported in the literature, along with the controversial clinical results indicate that longer follow-up studies are needed to evaluate the efficacy of this device. Meniscus repair with sutures have documented more



than 10 years favourable outcomes [12, 14, 30, 35] and remains the standard technique to which all other techniques must be compared.

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