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Arthroscopic deepening trochleoplasty for chronic anterior knee pain after previous failed conservative and arthroscopic treatment. Report of two cases

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ABSTRACT

PURPOSE: A proportion of patients having years of chronic anterior knee pain (AKP) that have not responded to non-operative modalities. Trochlear dysplasia have been found to be a cause for AKP. By restoring the anatomy with a trochleoplasty procedure the patellofemoral joint is unloaded. This study is a prospective 2 year follow-up study, based on two cases with chronic AKP for several years and having severe trochlear dysplasia and both were successfully treated by arthroscopic deepening trochleoplasty. **METHODS:** Case one was a 46 year old woman with chronic anterior knee pain (AKP). Imaging showed lateral trochlear inclination angle of 2°, trochlear asymmetry 0.36, central height 81% and medial height 83%. The preoperative Kujala score was 70 and Knee injury and Osteoarthritis Outcome Score (KOOS) subscale for pain was 67. Case two was a 26 year old man troubled by AKP and knee joint effusion for >8 years without any instability in the history. Imaging showed lateral trochlear inclination angle of 6°, trochlear asymmetry 0.25, central height 76% and medial height 78%. The preoperative Kujala score was 49 and KOOS subscale for pain was 72.

RESULTS: The postoperative Kujala score was for case one 82 and for case two 81. The postoperative KOOS subscale for pain was for case one 89 and for case two 92. Improvement in the KOOS subscale for sport and recreational activities and quality of living were also found.

CONCLUSION: This is the first case report to demonstrate that patient having had years of chronic AKP and trochlear dysplasia can be successfully treated by arthroscopic trochleoplasty.

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1. Introduction

1.1. Non operative management

For more than a century the source of pain and the treatment of anterior knee pain (AKP) or patellofemoral pain (PFP) has challenged physicians. For the past decade or more, based on substantial evidence, there has been a general consensus, that the treatment of choice is conservative, since a proportion of the patients improve by this approach. A number of conservative modalities have been documented to be effective for most patients either alone or in combination. The most important modalities seem to be exercises for the quadriceps, the hip muscles and the core stability training [1], but also foot orthosis [2] and braces [3] are recognized. A newer treatment modality for AKP is injection in the musculus vastus lateralis with Botulinum toxin type-a [4]. A 5.7 years follow-up in patients with AKP found that 50 percent still had pain at the

time of follow-up and that 13 percent had increased pain and in 74% the level of sport activity was affected [5]. Similar disappointing longtime follow-ups for patients troubled by AKP have later been confirmed by others [1]. With respect to this proportion of patients with chronic AKP, there is little consensus of treatment. A recent study reported that 22% of patients having patellofemoral (PF) arthroplasty described adolescent or early adulthood anterior knee pain as compared to 6% in patient having medial unicompartamental arthroplasty ($p < 0.001$) [6]. This means there is a clear link between AKP and later development of PF osteoarthritis.

1.2. Surgery for AKP

A number of surgeries have been applied for AKP, here among, arthroscopy, lateral release or lengthening, tibial tubercle osteotomy and femoral rotational osteotomies, however trochleoplasty has only seldom be used for anterior knee pain, and there seems to be a general agreement among PF surgeons to avoid trochleoplasty, except when there is patellar instability [7–9]. In recent years general knowledge for the pathomorphology of both patellar instability and AKP increased notably and there a many

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similarities. We now know that both trochlear dysplasia (TD), increased TT-TG distance, Patella Alta and increased antetorsion of the femur are disposing factors for both patellar instability and AKP. Presumably AKP can be perceived as one extreme of patellar instability, meaning that patellar instability is a continuum, starting with AKP in one end of the spectrum and a permanent dislocated patella in the other end.

1.3. Purpose

This study is based on two patient cases and both were troubled by chronic AKP and with MRI that demonstrated severe TD. Both patients were the first two operated by arthroscopic deepening trochleoplasty (ADT) for this condition and they were followed prospectively. This is the first case report to demonstrate that patient having had years of chronic AKP and trochlear dysplasia can be successfully treated by arthroscopic trochleoplasty, a technique that have been used routinely in a private hospital by the author since 2008 and detailed information can be obtained from previous papers [10,11]. The theoretic scientific background for a trochleoplasty procedure for patients with chronic AKP and TD will be discussed.

2. Material and methods

The work are in line with the SCARE criteria [12].

2.1. Case A

A 46-year old woman troubled for 20 years by unilateral anterior knee pain in the left knee without any trauma or instability in the history. She had undergone an arthroscopic plica resection in 2010, followed by a postoperative physiotherapy guided rehabilitation program consisting of exercises for the quadriceps, the hip muscles and the core stability training. The surgery and physiotherapy only increased the pain and she had advocated for a total knee replacement based on severe pain.

Clinical examination revealed the affected knee to be without knee joint effusion or retropatellar crepitus and there was a normal range of movement. Pain was easily elicited by the patella glide test, the patella was found to be stable medially and laterally, and a negative patella apprehension test was observed. The lateral retinaculum was not found to be tight. The knee was otherwise stable and no increased anteversion of the hip was found. Femoral anteversion and foot pronation were found normal by clinical examination only.

In 2014 an MRI of the knee demonstrated medial and lateral compartments with normal cartilage and menisci. The cartilage in the PF joint was found to be normal, except for light wear distally at the patella site. TD was observed. The following radiographic parameters were measured: lateral trochlear inclination angle of 2°, trochlear asymmetry 0.36, central height 81% and medial height 83%. The TT-TG distance was 11.2 mm, Insall-Salvati index 1.14, Caton Dechamps index 1.02 and patellochlear index 0.51. During the ADT in 2014 the only pathology observed, besides the TD, was excessive lateral overhang of the patella during flexion. Operative pictures can be seen from Fig. 1.

About one year after the ADT the type of pain that the patient had experienced preoperatively was gone, but she had started to have a new type of pain in the back of her knee after walking longer distances. In 2016 the MRI significant improvement in trochlea morphology, but lateral patellar tilt was observed. At clinical examination a tight lateral retinaculum was observed with tenderness over the lateral part of the PF joint. 16 months after her ADT, she had a new arthroscopy, revealing a normal looking trochlear groove. A lateral retinacular lengthening was done.

After the second surgery she had a new physiotherapy-guided rehabilitation program with fast recovery. At follow-up 10 weeks after the second surgery she indicated that her pain was significantly reduced. The follow-up was at 30 months.

2.2. Case B

A 26-year old man was troubled by unilateral anterior knee pain and knee joint effusion in his right knee for more than 8 years without any history of trauma or instability. In 2006 an arthroscopic debridement of a retropatellar cartilage lesion and microfracture were performed, followed by a postoperative physiotherapy-guided rehabilitation program consisting of an initial non-weight-bearing regime followed by progressively increased knee and hip muscle exercises. This did not reduce the pain.

Clinical examination of the affected knee revealed mild knee joint effusion, considerable retropatellar crepitus during flexion and extension, normal range of movement and easy pain by patella glide test. The patella was found medial and lateral stable and negative patella apprehension test was observed. The lateral retinaculum was not found to be tight. The knee was found stable and no increased anteversion of the hip was found. Femoral anteversion and foot pronation were found normal by clinical examination only.

An MRI of the knee in 2015 demonstrated medial and lateral compartments with normal looking cartilage and menisci. In the PF joint, wear of the trochlear and patellar cartilage were found. The patellar cartilage was uneven, but without disruptions. Severe TD was observed. The following radiographic parameters were measured: lateral trochlear inclination angle of 6°, trochlear asymmetry 0.25, central height 76% and the medial height 78%, TT-TG distance 14.7 mm, Insall-Salvati index 1.20, Caton Dechamps index 1.04 and patellochlear index 0.32.

During the ADT, TD were observed and grade 2–3 cartilage changes on the medial facet of the patella, with uneven cartilage and diffuse grade 1 cartilage changes in the trochlear groove were found. Also diffuse grade 2 changes at the medial femoral condyle and grade 1 changes on the tibial plateau.

2.2.1. The follow-up was after 26 month

The knees of both patients were operated by the same experienced surgeon having ADT [11,13,14] by suprapatellar portals, release of cartilage flake in the trochlea, and the trochlea was made deeper and lateralised by shaver burrs. Finally the cartilage flake was re-inserted into the new trochlear groove, using resorbable tapes and biocomposite anchors. See Fig. 1. In case B the retropatellar uneven cartilage were smoothed using a radiofrequency probe. Postoperatively, no braces were used and full weight bearing and free range of movement was allowed. A rehabilitation program was started within the first postoperative week.

2.2.2. Ethical standards

The local Ethics Committee of Copenhagen approved the study H–C-2009-010 (nr 21296) and it was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. All patients gave their informed consent to participate in the study.

3. Results

Both patients had reduced pain and knee scores improved following surgery. For pre and postoperative knee score see Table 1. An example of pre and postoperative MRI scan can be seen from Fig. 2.

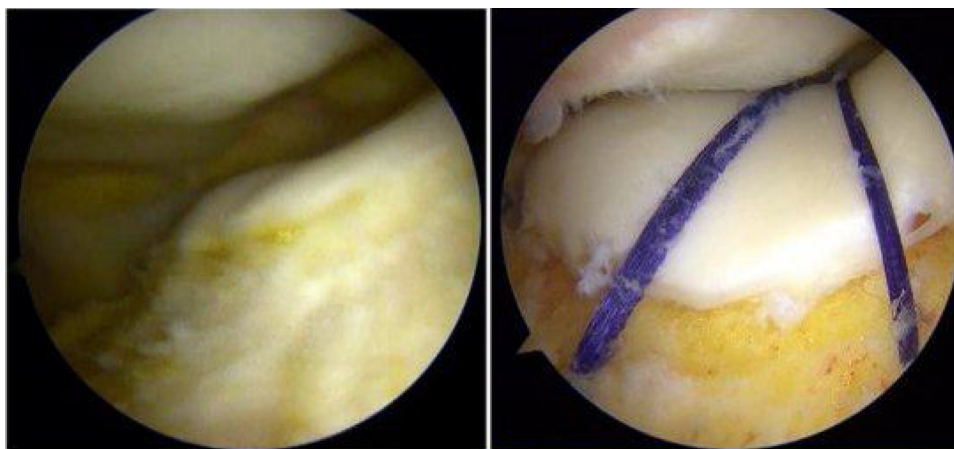


Fig. 1. This is an arthroscopic evaluation of the trochlea looking from a superior portal. This demonstrate the trochlea before after the arthroscopic deepening trochleoplasty.

Table 1
The pre- and post-operative Kujala score and KOOS score for case one and case two.

KOOS score			Kujala score		
Patient	Preoperatively	Postoperatively	Patient	Preoperatively	Postoperatively
	Pain	Pain	A	70	82
A	67	89	B	49	81
B	72	92			
	Symptoms	Symptoms			
A	82	71			
B	86	92			
	ADL	ADL			
A	78	93			
B	79	86			
	Sport/Rec	Sport/Rec			
A	40	85			
B	25	45			
	QOL	QOL			
A	38	56			
B	44	81			

4. Discussion

The results of these two cases followed prospectively, revealed that both patients experienced significantly less pain and had better knee scores, indicating that AKP in combination with severe TD may respond positively from arthroscopic trochleoplasty. The results obtained correspond to the findings from Goutallier [15] who in 2002 demonstrated good results doing trochleoplasty for patients with chronic AKP.

Numerous scientific papers indicate that increased PF forces based on TD could be a factor for AKP. Powers [16] observed that patients with AKP are more likely to have TD, compared to a group of individuals without AKP. That was supported by Keser et al. [17] who observed that the lateral trochlea inclination angle, which is associated with TD, was significantly lower in subjects with AKP compared to patients without. However in a systematic review with meta-analysis, only limited documentation was found reporting AKP in associated with MRI findings, but bisect offset and CT congruence angle were found abnormal when compared to controls [18]. Papers are generally examining by parameters that are not associated with TD, and the typical misinterpretation is to overlook, that the TD is localized in the most proximal part of the knee [19]. For example when measuring the sulcus angle relative distally in the knee, even though TD is present the angle has often normalized [20].

Questions have been raised if AKP later in life can lead to arthritis and Conchie et al. found 7.5 times more risk of PF arthritis if they had AKP in adolescence [6]. This supports the findings from Utting

et al., who found a significant number of patients with PF arthritis have described preceding anterior knee pain in their adolescence and early adult years [21]. Several others have found a relationship between low lateral trochlea inclination angle or/and trochlea dysplasia and the cartilage wear/PF arthritis [22–25]. Also a reduced trochlear depth has been found to correlate with chondromalacia patella [25,26].

Biedert et al. [27] demonstrated by including anterior posterior measurement in relation to the width of the knee, that one of the characteristics for TD, is that the central trochlea height, is significantly higher compared to normal knees, indicating increased bone in the trochlea area. Supporting the theory of too much pressure in the PF joint, based on too much bone, is the work from Powers et al. observing that patients with AKP, have elevated hydrostatic pressure and also increased water content in the patella [28]. In a MRI study comparing AKP patient with normal individuals, a significant higher post exercise thinning of the PF cartilage, was observed in the AKP group [29,30]. Draper et al. measured increased metabolic activity in the patella and trochlea area using PET/CT scans and found that the tracer uptake was significantly correlated to the degree of pain [31]. Van Haver et al. found that simulated TD in a cadaver model increased the pressure in the PF joint [32]. Farrokhi et al. found significantly higher PF stress forces at 15° of flexion in subjects with AKP compared to controls [33]. Based on those findings it was hypothesized, that increases pressure in PF joint can be a result of TD based on too much bone in the trochlear area, and that the increased PF pressure results in wear of cartilage and this may be followed by synovitis known to induce pain [34]. Alternatively

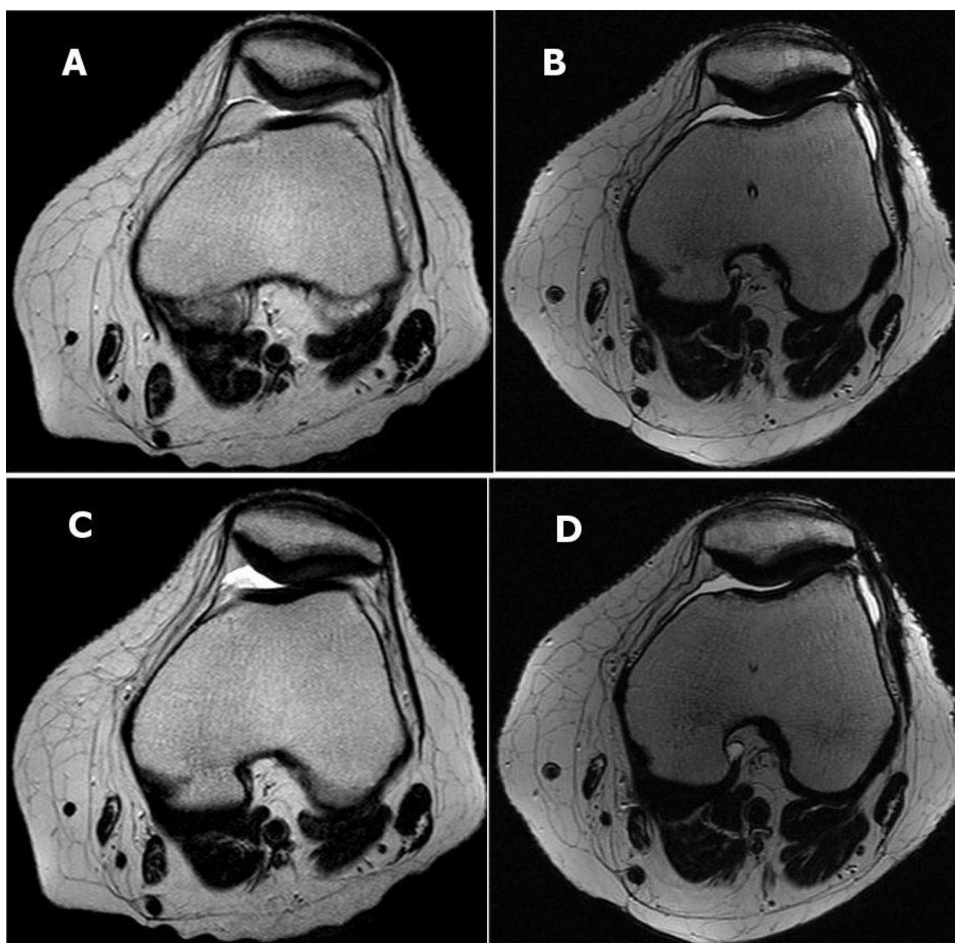


Fig. 2. This demonstrates the pre (A and C) and postoperative (B and D) MRI at two proximal levels.

the pain can be induced by or in conjunction with high pressure in the subcondral bone also known to induce pain.

Based on all those indicative parameters it therefore seemed likely, that a deepening of the trochlear groove by a trochleoplasty would unload the PF joint and thereby reduce the pain. A mechanism equivalent to reduction of medial side knee pain by valgus producing osteotomies when a varus alignment is present. We have previously observed from patients with patella instability based on TD, that their pain were significantly reduced by an arthroscopic trochleoplasty [11]. Also supporting the theory of increased pressure with TD and the consequence of unloading by deepening the trochlea, is the editorial from Blønd and Donell presenting pain reduction by doing a resection arthroplasty, with deepening of the trochlear groove and removing degenerative trochlear cartilage as an alternative to PF arthroplasty in cases with severe TD and osteoarthritic changes [35]. The results from these two presented cases seem to support the theory of reduction of cartilage stress as the source of better knee scores by the ADT.

5. Limitation and alternative procedures

Despite the lack of clinical findings, those patients whose AKP might have been based on a tight lateral retinaculum (hyperpressure syndrome) should then have responded positive to a lateral retinaculum lengthening only [36]. However generally cautions have to be taken in considering this procedure when there is TD, since there is lack of medial osseous support and medial subluxations could be induced. Torsional femoral osteotomies have been found to decrease AKP [37]. However since none of our cases pre-

sented with increased anteversion clinically, this type of surgery was not considered. Anteromedializing osteotomies of the tibial tubercle, such as the Fulkerson osteotomy and the Maquet elevation procedure, both unload the PF joint and might have been good options. Nevertheless those procedures are not correcting the underlying pathomorphology. In respect to a modified version of the Fulkerson osteotomy, Jack et al., in a 5 year follow-up of patients with chronic AKP, found that the Kujala score went from 39.2 to 57.7 and with a success rate of 72% [38]. Patients with lowest Kujala score and younger patients benefitted the most. In a 11 years follow-up by Jenny et al. on 47 patients with AKP and who had undergone the Maquet procedure, a success rate at 62% were observed [39]. These results suggest that it is time to look for a more successful treatment option for those patients with chronic AKP and ADT could be an option, but more studies are needed. Also it import to emphasize that the arthroscopic trochleoplasty is a relative new and demanding surgery only for experts in arthroscopic surgery and special knowledge to the patellofemoral joint. In summary alternative well known surgical procedures may not be good alternatives in respect to the presented cases and cases with comparable pathomorphology.

6. Conclusion

Two cases both with chronic anterior knee pain and trochlear dysplasia demonstrated a positive improvement at more than 2 years follow-up after arthroscopic deepening trochleoplasty – positive in respect to both pain and knee scores. This is the first case report to demonstrate that patient having had years of chronic AKP

and trochlear dysplasia can be successfully treated by arthroscopic trochleoplasty.

Conflicts of interest

No conflicts of interest.

Funding

No funding.

Ethical approval

The local Ethics Committee of Copenhagen approved the study H-C-2009-010 (nr 21296) and it was performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki. All patients gave their informed consent to participate in the study.

Consent

The patients have given written consent.

Author contribution

Only on author.

Guarantor

Lars Blønd.

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