Original Article

Arthroscopic Patelloplasty and Circumpatellar Denervation for the Treatment of Patellofemoral Osteoarthritis

Gang Zhao[1,2], Yujie Liu[1], Bangtuo Yuan[1], Xuezhen Shen[1], Feng Qu[1], Jiangtao Wang[1], Wei Qi[1], Juanli Zhu[1], Yang Liu[1]

[1]Department of Orthopedics, Chinese People's Liberation Army General Hospital, Beijing 100853, China
[2]Department of Orthopedics, Chinese People's Liberation Army 261 Hospital, Beijing 100294, China

Abstract

Background: Patellofemoral osteoarthritis commonly occurs in older people, often resulting in anterior knee pain and severely reduced quality of life. The aim was to examine the effectiveness of arthroscopic patelloplasty and circumpatellar denervation for the treatment of patellofemoral osteoarthritis (PFOA).

Methods: A total of 156 PFOA patients (62 males, 94 females; ages 45-81 years, mean 66 years) treated in our department between September 2012 and March 2013 were involved in this study. Clinical manifestations included recurrent swelling and pain in the knee joint and aggravated pain upon ascending/descending stairs, squatting down, or standing up. PFOA was treated with arthroscopic patelloplasty and circumpatellar denervation. The therapeutic effects before and after surgery were statistically evaluated using Lysholm and Kujala scores. The therapeutic effects were graded by classification of the degree of cartilage defect.

Results: A total of 149 cases were successfully followed up for 14.8 months, on average. The incisions healed well, and no complications occurred. After surgery, the average Lysholm score improved from 73.29 to 80.93, and the average Kujala score improved from 68.34 to 76.48. This procedure was highly effective for patients with cartilage defects I-III but not for patients with cartilage defect IV.

Conclusions: For PFOA patients, this procedure is effective for significantly relieving anterior knee pain, improving knee joint function and quality of life, and deferring arthritic progression.

Key words: Denervation; Lateral Retinaculum; Patellofemoral; Patelloplasty

Introduction

Patellofemoral osteoarthritis (PFOA) commonly occurs among middle-aged and elderly people, especially among Asian women. Pathogenically, lower limb alignment abnormalities will result in wear and tear on cartilage in the patellar/groove joint surface, subchondral sclerosis, and osteophytosis.[1,2]

Patellofemoral osteoarthritis is a common cause of anterior knee pain and severely reduces the quality of life. In our hospital, we treated 156 PFOA patients using arthroscopic knee joint debridement, patelloplasty, circumpatellar denervation, and release of the lateral patellar retinaculum.

Methods

Basic information

A total of 156 PFOA patients (62 males, 94 females; ages 45-81 years, mean 66 years) were involved in this study. PFOA occurred on the left side in 73 patients and on the right side in 83 patients. The average medical history was 32 months (3 months to 10 years). All patients received conservative treatment that was ultimately unsuccessful. The clinical manifestations included recurrent swelling and pain in the knee joint; aggravated pain upon ascending/descending stairs, squatting down, or standing up; positive patellar grinding tests; pain mainly located at patellar edges; varying degrees of quadriceps femoris atrophy; and a sense of joint friction during activities. Knee-joint X-rays showed that the space between the patellofemoral joint was narrowed, and osteophytosis was present. Patellar axial slices showed that the patellofemoral joints degenerated, the space between patellofemoral joints was narrow, and the patella was inclined outwards.[3,4] T2-weight and three-dimensional-fat-suppressed spoiled gradient recalled echo sequence (3D-FS-SPGR) cartilage-sequence magnetic resonance imaging (MRI) showed that the cartilage on the patella and femoral groove joint surface had degenerated or was lost and was mainly accompanied by slight degeneration in the menisci and tibial joints [Figure 1].[5-7]

Access this article online

Quick Response Code:

Website: www.cmj.org

DOI: 10.4103/0366-6999.147820

Address for correspondence: Dr. Yujie Liu, Department of Orthopedics, Chinese People's Liberation Army General Hospital, Beijing 100853, China
E-Mail: liuyujie301@163.com

The inclusion criteria were as follows: Patients with PFOA, mainly from patella wear and osteophytosis only; intact femorotibial joints, meniscus, cruciate ligaments, and collateral ligaments; and normal lower-limb alignment and normal bending and stretching abilities.

Surgical procedures

All procedures in this group were performed by one highly-qualified orthopedic surgeon. Under local anesthesia, the surgical sites were disinfected and draped according to standard procedures, and the arthroscopy was approached from inside and outside of the knee eyes. Comprehensive detection was first conducted to assess the patellar trajectory and patellofemoral articular cartilage degeneration and to classify the cartilage defect. Next, the hyperplastic synovium, medial and lateral compartments, and lesions in the intercondylar fossa were cleared. The lateral patellar retinaculum was released under radio frequency, and the circumpatella was denervated [Figures 2 and 3]. Under arthroscopy, the surgeon observed the patellar trajectory, the bone blockage and cartilage wound margins affecting patellofemoral joint activities, and the osteophytes present around the ground patella. The aseptic dressing was applied externally, followed by bandaging with elastic bandages. The intraoperative photos and videos were saved.

After awakening from anesthesia, the patients began isometric quadriceps training. Patients began straight leg raising and knee flexion and extension training and started partial weight-bearing ambulation the day after surgery. Three weeks later, the patients began full weight-bearing walking.

Observation items and therapeutic evaluation

The arthroscopic articular cartilage samples before and after surgery were classified and evaluated using Lysholm and Kujala scores. Cartilage defects were classified using the Outerbridge method.[8] Lysholm knee scoring[9] is globally used for the comprehensive evaluation of patellofemoral joint disorders and includes 8 items: Limp, locking, pain, support, instability, swelling, difficulty in ascending stairs, and restriction in squatting. Kujala scoring[10] is used for the evaluation of patellofemoral joints and covers 13 items: Limp when walking, supporting weight, walking distance, symptoms occurring when ascending or descending stairs, squatting ability and symptoms, symptoms occurring when running or jumping, symptoms occurring when kneeling down for long periods, degree of knee joint pain, anterior knee swelling, accompanying abnormal patellar activity, occurrence of thigh muscle atrophy, and restriction upon knee joint bending. The above items were tested preoperatively and again during the last follow-up to evaluate the therapeutic effects and the improvement in knee joint functions after surgery.

Statistical methods

The results were analyzed using SPSS 19.0 (SPSS Inc. IL, USA). The quantitative data were expressed as mean ± standard deviation and tested with the paired *t*-test, with the significance level set at $\alpha = 0.05$. $P < 0.05$ indicates a significant difference.

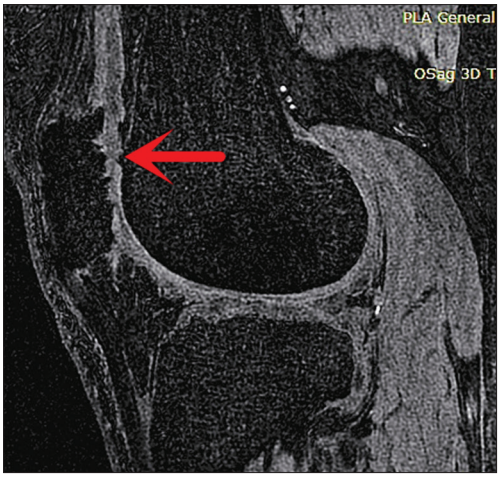

Figure 1: Three-dimensional fat-suppressed spoiled gradient recalled echo sequence cartilage sequence magnetic resonance imaging shows that the cartilage on the patella and groove surface degenerated (red arrow), and this degeneration was frequently complicated by slight degeneration in the menisci and tibial joints.

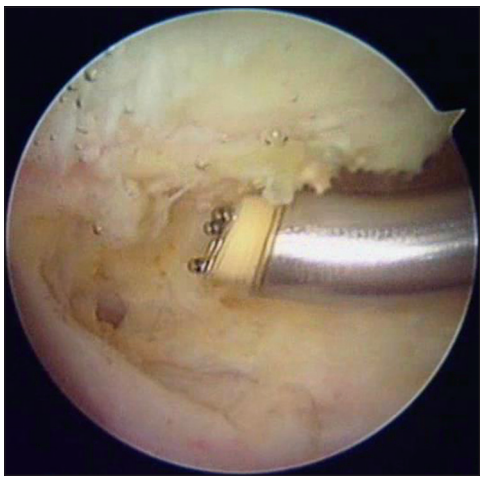

Figure 2: Release of the lateral patellar retinaculum.

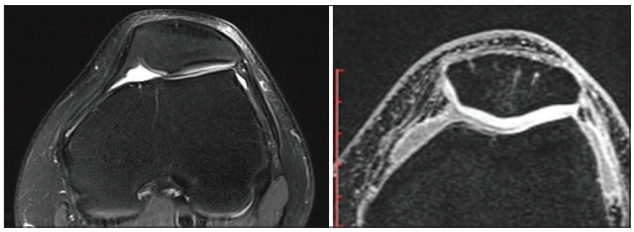

Figure 3: Preoperative and postoperative magnetic resonance imaging examination comparison chart. Axial patellar osteophytes were cleared, and the joint space increased.

Results

The surveyors completed the questionnaires during the follow-up visits. Seven of the 156 patients were missed, resulting in a follow-up rate of 95.5%. During 10-24 (18.8 ± 3.5) months of follow-up, the incisions all healed

well, and no recurrence, infection or nerve vascular injury occurred. After surgery, the average Lysholm knee score improved from 73.29 ± 4.48 to 80.93 ± 4.21 [Table 1], and the Kujala score improved from 68.34 ± 6.22 to 76.48 ± 6.54 [Table 2]. Paired *t*-tests did not indicate significant differences in any scale. Based on the patellofemoral articular cartilage degeneration classification, both scores were improved significantly among patients with cartilage defects I-III, but not among patients with cartilage defect IV. The scores for each specific item (e.g. limp, locking, instability, pain, swelling, ascending and descending stairs, squatting) were improved significantly (paired *t*-test) [Tables 3 and 4].

Table 1: Preoperative and postoperative lysholm scores

Items	Preoperative	Postoperative	*t*	*P*
Limp	3.52 ± 0.55	4.14 ± 0.48	5.955	0.0000
Support	3.61 ± 0.50	3.97 ± 0.51	3.517	0.0007
Locking	12.58 ± 1.13	13.31 ± 1.36	2.901	0.0046
Instability	17.85 ± 1.39	19.61 ± 1.19	6.741	0.0000
Pain	18.26 ± 2.30	21.17 ± 2.00	6.711	0.0000
Swelling	7.66 ± 0.73	7.60 ± 0.68	0.459	0.6470
Stairs	7.06 ± 0.70	7.76 ± 0.57	5.376	0.0000
Squatting	3.44 ± 0.40	4.07 ± 0.38	8.025	0.0000
Lysholm score	73.29 ± 4.48	80.93 ± 4.21	4.206	0.0001

Table 2: Preoperative and postoperative kujala scores

Items	Preoperative	Postoperative	*t*	*P*
Limp	3.51 ± 0.55	4.10 ± 0.46	6.654	0.0000
Support	3.60 ± 0.53	3.98 ± 0.49	3.683	0.0004
Walking distance	3.82 ± 0.63	4.25 ± 0.67	3.266	0.0015
Stairs	7.06 ± 0.70	7.76 ± 0.57	5.376	0.0000
Squatting	3.50 ± 0.44	4.10 ± 0.39	7.007	0.0000
Run	7.81 ± 0.68	8.45 ± 0.76	4.425	0.0000
Jump	7.92 ± 0.69	8.31 ± 0.91	2.388	0.0189
Knee down	7.50 ± 0.81	8.16 ± 0.49	4.891	0.0000
Pains	7.31 ± 0.93	8.47 ± 0.80	6.631	0.0000
Swelling	7.76 ± 0.70	7.75 ± 0.69	0.213	0.8327
Abnormal activity	7.14 ± 0.56	7.84 ± 0.48	6.618	0.0000
Atrophy	3.93 ± 0.56	3.97 ± 0.47	0.401	0.6891
Flexion restriction	4.32 ± 0.60	4.42 ± 0.46	0.929	0.3551
Kujala score	68.34 ± 6.22	76.48 ± 6.54	6.080	0.0000

Table 3: Comparison of pre- and post-operative lysholm score about cartilage damage grading

Cartilage degrees	Case number	Preoperative	Postoperative	*t*	*P*
Degree I	33	77.86 ± 4.95	85.64 ± 3.86	2.712	0.0266
Degree II	48	75.04 ± 3.44	82.11 ± 4.22	3.025	0.0049
Degree III	56	72.26 ± 4.47	81.07 ± 4.80	3.350	0.0018
Degree IV	19	68.86 ± 3.97	74.24 ± 3.82	1.104	0.2884
Total	156	73.29 ± 4.48	80.93 ± 4.21	4.206	0.0001

Table 4: Comparison of pre- and post-operative kujala score about cartilage damage grading

Cartilage degrees	Case number	Preoperative	Postoperative	*t*	*P*
Degree I	33	72.72 ± 5.81	79.75 ± 3.92	2.457	0.0338
Degree II	48	71.85 ± 4.31	78.28 ± 3.47	4.502	0.0001
Degree III	56	68.03 ± 4.20	74.51 ± 3.64	3.946	0.0004
Degree IV	19	61.29 ± 3.99	64.37 ± 4.01	1.963	0.0614
Total	156	68.34 ± 6.22	76.48 ± 6.54	6.080	0.0000

Discussion

Anatomical analysis of patellofemoral joint

The patellofemoral joint, composed of the patella and the femur groove, is a major component of the extension apparatus of the knee. Under normal gait, the patellofemoral joint bears 0.5- to 1-fold of the body weight.[11] However, the weight-bearing is increased to 3- to 4-fold of body weight upon walking up and down stairs and is maximized to 8-fold of body weight upon high bending.[12,13] This high stress causes wear and tear in the patellofemoral articular cartilage and thus accelerates its degeneration.

Anterior knee pain is mainly caused by an abnormal patellar trajectory (due to congenital deformity, injury or degeneration) or patellofemoral joint malalignment.[14] Patellar subluxation alters the contact surface of the patellofemoral joint and increases the pressure on the joint surface, which leads to abnormal stress imposed on the patella, structural destruction of the cartilage collagen fibers, and finally, cartilage wear, tear and degeneration. Because the patellae are rich in nerve endings, exposure of the nerve endings below the cartilage will also induce anterior knee pain.[15]

Patellofemoral osteoarthritis patients typically also have bony substance hyperplasia in the lateral patella. The tension on the lateral patellar retinaculum will lead to pressure on the lateral surface of the patellofemoral joint and finally to degeneration of the articular cartilage.[16]

According to Lin *et al*. study,[17] the incidence rate of PFOA among people older than 50 years is 6.3% and is higher among females. The wear and tear on the patellofemoral joint is intensified by long-term rapid and forced bending and stretching in the knee joint, which are major causes of PFOA. PFOA may occur alone or together with femorotibial arthritis. Non-surgical treatments include limitation of movement, pharmacologic symptom relief, and injection of hyaluronic acid into the articular cavity. As the condition progresses, however, the above treatments are unable to adequately relieve pain and/or symptoms. Traditional surgical therapies include advancement of the tibial tuberosity, patellofemoralarthroplasty, and total knee replacement. However, invasiveness, frequent bleeding and surgical risks limit the application of these approaches. Moreover, arthroplasty is unsuitable for young patients.

Local blocking of the patellofemoral joint was tested among patients whose femorotibial joint, meniscus, cruciate ligaments and collateral ligaments were all intact. The pain was resolved after the tests. These patients then underwent

release of the lateral patellar retinaculum to relieve the high external patellofemoral pressure for circumpatellar denervation. The results proved that the pain-killing effects were significant with few complications, despite the presence of varying degrees of cartilage defects.

Distribution of circumpatellar nerves

Circumpatellar nerves include the cutaneous nerves, the superior branch of the saphenous nerve, and the joint branch of the knee extensor muscle [Figure 4].[18,19] The superior branch of the saphenous nerve (also called the patellar branch) passes through the internal superior border of the patella into the subcutaneous prepatellar area and is located in the prepatellar skin. The joint branch of the knee extensor muscle includes the interior, medial and lateral femoral muscular branches; the knee joint muscular branch; and the anterior branch of the obturator nerve. The interior femoral muscular branch originates from the obturator nerve or saphenous nerve and is divided into two branches after entering the joint capsule. The lower branch supports the synovial structures in the interior patella and patellofemoral joint.[20]

In the knee joint ligament, each nerve passes through the joint capsule, is distributed in the articular synovial area, and forms the somatic nerve and autonomic nerve network in the joint. In one study,[21] no significant difference between the experimental and control group was observed (via microscopy) in articular cartilage thickness after the denervation of rabbit knees. Moreover, there was no effect on the articular cartilage tissue structure of the knee joint nerve branch, and the knee joint partial denervation therapy was determined to be feasible. Therefore, in TKA and arthroscopic debridement, through synovectomy, articular branch of the patella peripheral denervation, to reduce the patellofemoral joint pain has reasonable mechanism of anatomy.

Significance

The treatment of patellofemoral arthritis includes many surgical procedures, such as arthroscopic debridement, drilling or microfracture surgery, lateral retinaculum release, tibial tuberosity advancement, patella thin cut surgery, patellar resection, patellofemoralarthroplasty, and TKA, many of which can be combined. Arthroscopy and drilling or microfracture surgery may have an effect on mild to moderate cartilage damage, but the long-term efficacy remains unclear.[22] Simple lateral retinaculum release is only appropriate for patella displacement or tilt; in previous studies, the force line changes were effective, but the results were controversial.[23] The extensor force line was relatively normal in appropriate transposition within the anterior tibial tuberosity. There are reports that there is a significant pain relief effect of patella thin cut surgery for pure PFOA. However, this approach is not recommended for severe abrasions or when the patella thickness is <20 mm.[24] Patellar resection may lead to quadriceps weakness, reducing the range of motion and leaving the femoral condyle vulnerable to trauma and without enough protection. Isolated PFOA can be treated by patellofemoral joint replacement or total knee arthroplasty. Reported success rates of patellofemoral arthroplasty range from 44% to 90%. Total knee arthroplasty is a good choice for older patients, cases of severe functional limitations or bilateral knee involvement and for patients who perform mild physical labor. However, in relatively young patients or in very physically active PFOA patients, TKA is not the best choice.

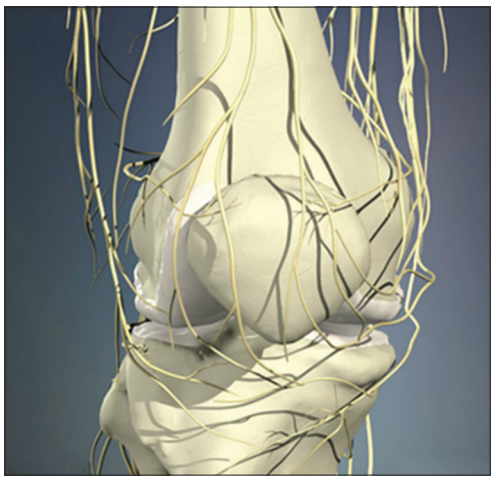

Figure 4: Circumpatellar nerve distribution schematic diagram.

The group of patients who received outpatient treatment to limit their activity and who received oral NSAIDs, glucosamine and intra-articular injections of sodium hyaluronate for more than 3 months experienced less-than-ideal relief.

The 3D-FS-SPGR sequence is recognized as one of the best academic cartilage MRI sequences.[25] This technique can show transparent cartilage clearly and can accurately locate not only large cartilage defects but also small superficial cartilage wear. SPGR increases the contrast of articular cartilage and subchondral bone to improve the signal to noise ratio of the cartilage image, allowing the cartilage to be displayed more clearly. Normal articular cartilage in the 3D-FS-SPGR sequence demonstrates a significantly high signal, and in the most areas of joint cartilage, delamination can be observed. Thin line, volume scanning and 3D reconstruction, and quantitative measurement of the thickness and volume of cartilage can also be performed to identify small lesions in the joint. The 3D-FS-SPGR sequence has high sensitivity and specificity for knee articular cartilage degeneration that is consistent with arthroscopy. Based on these findings, we can roughly judge the degeneration of articular cartilage by preoperative MRI. After arthroscopic surgery in mild to moderate osteoarthritis and I-III grade cartilage degeneration, knee pain relief was clear and the majority of joint function improved significantly.

The aims of treatment of PFOA are to recover the inosculation of the patellofemoral joint, balance the soft tissues, and eliminate the primary causes for patellofemoral joint pain. Patelloplasty is able to lower the patellar lateral pressure, correct the patellar motion trajectory, improve bad

contact on patellofemoral joint surfaces, prevent wear and tear on the patellofemoral joint, and delay degeneration.[26] Radiofrequency burning with denervation is able to clear away a portion of the circumpatellar nerves, reduce the nerve conduction of pain, and relieve anterior knee pain.[27-30] With the above treatments, we eliminated the biomechanical factors affecting knee joint activities and blocked the vicious circle of degeneration and injury. Moreover, the articular cavity was washed with enough saline water to fully eliminate the worn areas and inflammatory factors and to alleviate inflammatory reactions, which were the objectives of treatment.[31]

This technique uses conventional arthroscopic electrical cauterization of peripatellar synovial tissue, partial removal of the peripheral nerve with patella osteophyte drill grinding, and grinding of the hyperplasia. This operation can remove diseased tissue while maximizing preservation of normal cartilage and synovial hyperplasia, clean up around the patella, and improve patellofemoral involution relations. The operation reduces inflammatory substances caused by the friction of the patellofemoral joint hyperplasia, thereby reducing the pain. The patella is composed of different bundle branches, but peripheral nerve distributions overlap. Therefore, even if some denervation exists, it will not completely block the patellar plexus nerve, preventing sensory loss in the patellar skin. This procedure of cutting the patellar plexus nerve around the patellar cartilage does not damage the patella in front of the tissue. The main patellar vascular holes are on the front ¼ area of the patella and hence it will not result in patellar fracture, necrosis or other complications.

Moseley *et al*. and Kirkley *et al*.,[32,33] through large randomized controlled studies, found that there was no difference between arthroscopic surgery and control subjects after treatment for osteoarthritis of the knee. Thus, they concluded that arthroscopic surgery is just a placebo treatment for the disease. While this conclusion about arthroscopic techniques has a certain reference value, it was published more than 10 years ago, so it does not represent the current state of emerging technologies and new perspectives. The technique described here flushes the inflammatory factors to relieve inflammation, removes the source of patellofemoral malalignment osteophytes, and denervates nerve endings; although it cannot reverse the process of osteoarthritis, this approach was able to relieve pain and delay joint replacement surgery.

However, this procedure was not very effective for patients with a low degree of cartilage defect and thus should not be their first treatment choice. The follow-up results show that among patients with degree I-III cartilage degeneration, both Lysholm and Kujala scores improved significantly.

In conclusion, the therapeutic effects for the treatment of PFOA with arthroscopic patelloplasty and circumpatellar denervation are closely associated with the degree of patellofemoral articular cartilage degeneration. This procedure is a minimally invasive procedure that lies between conservative treatment and joint replacement surgery. Arthroscopic surgery has the advantages of less trauma and rapid recovery after surgery. Moreover, this approach is accepted by patients who do not obtain satisfactory results after conservative treatment and cannot afford the financial cost of joint replacement. This technique, as a therapeutic method, is suitable for mild-to-moderate patellofemoral arthritis, relieves pain to a certain extent, improves quality of life, delays joint replacement, and delays the progression of PFOA. However, the main limitation of this procedure is that it is difficult to obtain a better curative effect for patients with more severe articular cartilage degeneration and poor knee function. The long-term effects of this procedure will require further clinical observation and research.

References

1. Rodriguez-Merchan EC. Surgical treatment of isolated patellofemoral osteoarthritis. HSS J 2014;10:79-82.
2. Lüring C, Tingart M, Drescher W, Springorum HR, Kraft CN, Rath B. Therapy of isolated arthritis in the patellofemoral joint: Are there evidence-based options? Orthopade 2011;40:902-6.
3. Fox AJ, Wanivenhaus F, Rodeo SA. The basic science of the patella: Structure, composition, and function. J Knee Surg 2012;25:127-41.
4. Fredericson M, Yoon K. Physical examination and patellofemoral pain syndrome. Am J Phys Med Rehabil 2006;85:234-43.
5. Harris JD, Brophy RH, Jia G, Price B, Knopp M, Siston RA, *et al.* Sensitivity of magnetic resonance imaging for detection of patellofemoral articular cartilage defects. Arthroscopy 2012;28:1728-37.
6. Thuillier DU, Souza RB, Wu S, Luke A, Li X, Feeley BT. Imaging demonstrates early changes in the lateral patella in patients with patellofemoral pain and maltracking. Am J Sports Med 2013;41:1813-8.
7. Agnesi F, Amrami KK, Frigo CA, Kaufman KR. Comparison of cartilage thickness with radiologic grade of knee osteoarthritis. Skeletal Radiol 2008;37:639-43.
8. Outerbridge RE. Further studies on the etiology of chondromalacia patellae. J Bone Joint Surg Br 1964;46:179-90.
9. Lysholm J, Gillquist J. Evaluation of knee ligament surgery results with special emphasis on use of a scoring scale. Am J Sports Med 1982;10:150-4.
10. Kujala UM, Jaakkola LH, Koskinen SK, Taimela S, Hurme M, Nelimarkka O. Scoring of patellofemoral disorders. Arthroscopy 1993;9:159-63.
11. Defrate LE, Nha KW, Papannagari R, Moses JM, Gill TJ, Li G. The biomechanical function of the patellar tendon during in-vivo weight-bearing flexion. J Biomech 2007;40:1716-22.
12. Ateshian GA, Hung CT. Patellofemoral joint biomechanics and tissue engineering. Clin Orthop Relat Res 2005;81-90.
13. Besier TF, Fredericson M, Gold GE, Beaupré GS, Delp SL. Knee muscle forces during walking and running in patellofemoral pain patients and pain-free controls. J Biomech 2009;42:898-905.
14. Iliadis AD, Jaiswal PK, Khan W, Johnstone D. The operative management of patella malalignment. Open Orthop J 2012;6:327-39.
15. Saavedra MÁ, Navarro-Zarza JE, Villaseñor-Ovies P, Canoso JJ, Vargas A, Chiapas-Gasca K, *et al.* Clinical anatomy of the knee. Reumatol Clin 2012-2013;8 Suppl 2:39-45.
16. Wilson T. The measurement of patellar alignment in patellofemoral pain syndrome: Are we confusing assumptions with evidence? J Orthop Sports Phys Ther 2007;37:330-41.
17. Lin JH, Kang XZ, Li H. The high prevalence of knee osteoarthritis in a rural Wuchuan population (in Chinese). Chin J Orthop 2009;29:929-33.
18. Cheng Y, Gao XH, Hou QZ. Histological and morphological observations on the distribution of circum-patella nerve fiber (in

Chinese). Chin J Orthop 2013;33:1120-5.
19. Kennedy JC, Alexander IJ, Hayes KC. Nerve supply of the human knee and its functional importance. Am J Sports Med 1982;10:329-35.
20. Yu ZH, Cai X, Zhao WD. Clinical anatomy of the innervation of knee joint (in Chinese). Chin J Clin Anat 2008;26:11-6.
21. Xiao CG, Deng XH, Zhang XH. Effects of ultrastructure on the knee articular cartilage of the knee osteoarthritis rabbit model after selective denervation (in Chinese). J Anat Res 2013;35:418-21.
22. Herrenbruck TD, Mullen DJ, Parker RD. Operative management of patellofemoral pain with degenerative arthrosis. Sports Med Arthrosc Rev 2001;9:312-24.
23. Clifton R, Ng CY, Nutton RW. What is the role of lateral retinacular release? J Bone Joint Surg Br 2010;92:1-6.
24. Vaquero J, Calvo JA, Chana F, Perez-Mañanes R. The patellar thinning osteotomy in patellofemoral arthritis: Four to 18 years' follow-up. J Bone Joint Surg Br 2010;92:1385-91.
25. Hunter DJ, Guermazi A, Lo GH, Grainger AJ, Conaghan PG, Boudreau RM, *et al.* Evolution of semi-quantitative whole joint assessment of knee OA: MOAKS (MRI Osteoarthritis Knee Score). Osteoarthritis Cartilage 2011;19:990-1002.
26. Judet H, Judet J, Ben Hamida H. Patelloplasty for extensive lesions of the patellar cartilage. Chirurgie 1992;118:529-32.
27. Gargiulo P, Reynisson PJ, Helgason B, Kern H, Mayr W, Ingvarsson P, *et al.* Muscle, tendons, and bone: Structural changes during denervation and FES treatment. Neurol Res 2011;33:750-8.
28. Barton RS, Ostrowski ML, Anderson TD, Ilahi OA, Heggeness MH. Intraosseous innervation of the human patella: A histologic study. Am J Sports Med 2007;35:307-11.
29. Namazi N, Jaberi FM, Pakbaz S, Vosoughi AR, Jaberi MM. Does patellar rim electrocautery have deleterious effects on patellar cartilage? Knee 2014;21:524-8.
30. Wetzels T, Bellemans J. Patellofemoral osteoarthritis treated by partial lateral facetectomy: Results at long-term follow up. Knee 2012;19:411-5.
31. Lützner J, Kasten P, Günther KP, Kirschner S. Surgical options for patients with osteoarthritis of the knee. Nat Rev Rheumatol 2009;5:309-16.
32. Moseley JB, O'Malley K, Petersen NJ, Menke TJ, Brody BA, Kuykendall DH, *et al.* A controlled trial of arthroscopic surgery for osteoarthritis of the knee. N Engl J Med 2002;347:81-8.
33. Kirkley A, Birmingham TB, Litchfield RB, Giffin JR, Willits KR, Wong CJ, *et al.* A randomized trial of arthroscopic surgery for osteoarthritis of the knee. N Engl J Med 2008;359:1097-107.

Received: 17-10-2014 **Edited by:** Xiuyuan Hao
How to cite this article: Zhao G, Liu Y, Yuan B, Shen X, Qu F, Wang J, *et al*. Arthroscopic Patelloplasty and Circumpatellar Denervation for the Treatment of Patellofemoral Osteoarthritis. Chin Med J 2015;128:79-84.
Source of Support: Nil. **Conflict of Interest:** None declared.