MANAGEMENT STRATEGIES FOR POST-TRAUMATIC KNEE STIFFNESS

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ABSTRACT

Backgrounds and Objectives: This study aimed to retrospectively analyze the clinical data of 112 post-traumatic knee stiffness (PTKS) patients treated in our hospital from February 2004 to November 2010 and explore the treatment strategies for post-traumatic stiffness of the knee joint. The objective of the study was to investigate management strategies for post-traumatic knee stiffness.

Methods: From February 2004 to November 2010, 112 patients with post-traumatic knee stiffness were treated in our department. Clinical data were studied retrospectively, and the differences of range of motion and Hospital for Special Surgery score of the knee before and after the treatment were also analyzed statistically.

Results: Sixty – three patients were treated with rehabilitation, 24 patients were treated with arthroscopy, and 25 were treated with a minimally invasive "hybrid technique" that included the lysis of intra-articular and extra-articular adhesion, the follow-up duration was 3 to 72 months, with a mean of 18.5 months. Average range of motion increased 55° in the rehabilitation group, 70° in the arthroscopy group, and 75° in the hybrid technique group. Both range of motion and Hospital for Special Surgery scores of the knee before and after treatment for each group showed a statistically significant difference.

Conclusion: Although the pathology of post-traumatic knee stiffness is complex, satisfactory results can be obtained using individualized treatment based on the course of the disease, the degree of extensor mechanism involved, physical examination, and ancillary results.

Keywords: Post-traumatic, Knee joint, Stiffness, Treatment strategy.

INTRODUCTION

Posttraumatic knee stiffness (PTKS) is a severe complication of the knee joint after trauma or surgery. It can be classified into 2 types: intra-articular adhesion type and extra-articular adhesion type. In addition to limitations of motion, PTKS can also be classified into flexion limitations and extension limitations. Liu et al hold the view, that due to high-velocity injury and improper treatment and rehabilitation and the occurrence of infection after surgery, intra-articular and extra-articular adhesion with flexion and extension limitations coexist in PTKS. The treatment of PTKS is classified into 2 categories: conservative treatment and surgical treatment. The former refers to formal systematic rehabilitation treatment; the latter includes the traditional extensor apparatus, improved quadriceps plasty, and arthroscopic lysis. In the clinical setting, it is still a challenge for orthopaedists to select the appropriate treatment to achieve a satisfactory effect. In this research, we retrospectively analyzed the clinical data of 112 patients with PTKS who received treatment from February 2004 to November 2010 in our hospital to investigate treatment strategies for PTKS.

PATIENTS AND METHODS

A Total of 112 patients were included in this study, 72 were male and 40 were female; their ages ranged from 7 to 74 years, with an average age of 39 years. Twenty-one patients had knee ligament damage, 16 had a tibial plateau fracture, 18 had a femoral fracture, and 3 had a femoral fracture combined with a femoral condyle fracture. The stiffness duration (the initial damage before rehabilitation) ranged from 0.5 to 108 months, with an average of 15 months (Table 1).

Treatment

Rehabilitation

Assessment included the early, middle, and end stage of the evaluation, including the patient's general condition, psychological state, limb alignment, gait, condition of the skin and soft tissue around the knee joint, range of motion (ROM) of the knee and adjacent joint (with or without the "end point sign" (a positive result refers to a knee joint that was passively moved to a certain angle but couldn't buckle further), patellar motion (movement up and down and side to side), adaptation of arthritis and the surrounding skin and soft tissue,

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Table 1: *Clinical data of 112 patients with posttraumatic knee stiffness.*

Items	*Rehabilitation Group (n = 63)*	*Arthroscopy Group (n = 24)*	*Combined Minimally Invasive Group (n = 25)*
Male	45	10	17
Female	18	14	8
Age	37 ± 16.0	44 ± 11.9	39 ± 12.2
Patella fracture	16	0	0
F shaft fracture	6	0	12
Tibial plateau fracture	8	6	2
Supracondylar fracture of femur	8	2	2
Intercondylar fractures of the femur	3	4	0
Ligamentous injury of knee joint	11	10	0
Tibia intercondylar eminence fracture	4	2	0
Ipsilateral femoral patella fracture	2	0	2
Ipsilateral femoral tibial plateau fracture	0	0	3
Ipsilateral femoral patella tibia fracture	2	0	4
Femoral combined condyle fracture	3	0	0
Stiffness duration (months)	9 ± 21.4	7 ± 8.4	25 ± 26.7

strength measurement of muscles around the knee joint, degree of original damage, degree of internal fixation and stability, and degree of fracture healing, Hospital for Special Surgery scoring included the degree of swelling after treatment, fluid in the joints, the ROM of the knee joint, muscle strength around the knee joint, whether or not treatment was adjusted, the presence of internal fixation, the presence of looseness breakage or removal, and whether surgical intervention was needed. After evaluation, rehabilitation was conducted by the same set of therapists or physiotherapists and included physical therapy, spa massage, physiotherapy, low – frequency electrical stimulation, continuous passive activities, and therapy with a pneumatic pump or ice compresses, or other treatments.

Surgery

Arthroscopy

Firstly, we created a space where the arthroscope was to enter. Under the guide of an arthroscope, it was released from the inferior patella with a blunt needle drill in the following order: inner and outer groove, suprapatellar bursa, bilateral retinaculum, patellar joint, intercondylar fossa, bilateral compartment, and adhesions between the femur and the quadriceps. In the end, the patella was reactivated. Second, massage is recommended to help gently and gradually bend the knee joint after release. When resistance became getting greater, forceful movement was avoided by all means. A microscopic check was necessary to ensure that the remaining adhesion are resected at the same time until reaching a satisfactory passive mobility.

Combined Minimal Invasive Surgery

A group of researchers explored the arthroscopic intra-articular release technique combined with extra- articular zigzag quadriceps plasty (combined minimally invasive treatment). The method of arthroscopic release was detailed previously. Extra-articular lysis consisted of incising longitudinally at the point 5 cm to the upper and outer edge of the patella and then extending 4 cm to the proximal thigh. The vastus lateralis muscle was sharply dissected to expose the far end of the femur. The knee extension system was dissected from the bilateral to the anterior and from the proximal end of the subperiosteal to the distal end by the elevator. In different locations, a transverse incision was made anterior and inferior to the contracture muscle. The depth of the notch was almost one-third of the entire muscle thickness, as many letters "Z." The first incision was 2.5 to 3 cm to the patellar edge. The two incisions were separated by 3 cm. According to the severity of the contracture, it is okay to make 3 to 5 incisions. In this way, the contracture iliotibial band

can be partly cut off to stop bleeding thoroughly in direct vision using an electric knife. Between the femur and extensor mechanism, the articular cavity drainage was prepared.

Postoperative analgesia
Pain was controlled by a femoral nerve sheath catheter block and oral non-steroidal analgesics, positioned by the Stimu Long Plus 19 g nerve locator (Germany). A mixture of 10 ml of 2% lidocaine and 10 ml of 1% novocaine was injected 5 minutes before training via catheter.

Evaluation of Therapeutic Efficiency
The ROM and HSS score are adopted to evaluate the knee joint function of patients before and after treatment and at the point of follow up. According to Judet criteria, the curative efficiency is classified into 4 degrees: Excellent; buckling more than 100 DHS; Good, 80 – 100 DHS; Moderate, 50 – 80 DHS; and Worst, less than 50 DHS.

Statistics
Differences in the knee joint ROM and the HSS function scoring were compared by paired t-test before and after treatment. Using SPSS statistical software package 11.5, the difference was considered statistically significant when $P < 0.05$.

RESULTS
One-hundred-twelve patients (Table 1) were assigned to the rehabilitation group (63 patients, 56%), arthroscopy group (24 patients, 21%), and a combination of the minimally invasive group (25 patients, 23%). The knee ankylosis duration ranged from 0.5 months to 108 months, with an average of 15 months. The rehabilitation group was 10.6 months, including 16 patients whose rehabilitation lasted longer than 12 months. The arthroscopy group's rehabilitation was 6.3 months; all of the patients had intra-articular trauma (fracture of the tibial plateau and femoral condyle, avulsion fracture of the cruciate ligament, cruciate ligament injury, and meniscus injury). The combined minimally invasive group's rehabilitation lasted 29.4 months; 80% had femoral and femoral condyle fractures. All patients were followed for 3 to 72 months, with an average of 18.5 months. Twenty – five patients were lost due to inaccurate telephone number or address.

ROM of the Knee Joint
ROM was significantly improved, with an average of 55 DHS in the rehabilitation group, 70 DHS in the arthroscopy group, and 75 DHS in the combined minimally invasive group. Differences in ROM and HSS score between groups before and after treatment was statistically significant ($P = < 0.05$) (Table 2).

Articular Function Evaluation and Patient Satisfaction
According to the Judet criteria, in the rehabilitation group, 38 patients' outcomes were excellent, 19 were good, and 6 were moderate. In the arthroscopy group, 17 patients' outcomes were excellent, 5 were good, and 2 were moderate. In the combination of minimally invasive group, 16 patients' outcomes were excellent, 8 were good, and 1 was poor. The average HSS score increased from 75 points (44 – 93 points) during hospitalization to 91 points (78 – 95) at the final follow-up in the rehabilitation group. In the arthroscopy group, it increased from 76 points (40 – 91 points) to 91 points (73 – 100). In the combined minimally invasive group, it increased from 72 points (53 – 89 points) to 90 points (78 – 98). The differences between the three groups were statistically significant ($P = 0.000$). The follow-up showed a generally improved level of function in living and working with a satisfactory result.

Complications
No skin necrosis, tearing, wound dehiscence, or refracture was found. A short-term extension stranded phenomenon was found, but no hysteresis remained at final follow-up.

DISCUSSION
Choice of Treatment
PTKS is the most severe complication around the knee joint after trauma or surgery. Currently, the treatment of PTKS can be classified into three types: rehabilitation, arthroscopic arthrolysis, and quadriceps plasty. The traditional Thompson quadricepsplasty, which has

Table 2: *Comparison of ROM and HSS score in the three groups before and after treatment.*

	Case Number	*ROM*			*P value*	*HSS*			*P value*
		Before	*After*	*T value*		*Before*	*After*	*T value*	
Rehabilitation group	63	54 ± 25.0	99 ± 21.8	-11.4	0.000	75 ± 10.0	90 ± 6.6	-11.1	0.000
Arthroscopy group	24	46 ± 27.0	117 ± 13.4	-11.6	0.000	74 ± 8.8	91 ± 5.9	-6.0	0.000
Combination of minimally invasive group	25	38 ± 24.7	113 ± 16.0	-15.2	0.000	71 ± 17.1	90 ± 6.3	-4.8	0.000

a history of more than 50 years, is called lysis of the extensor mechanism, but serious surgical trauma has remained. In the late 1960s, Judet proposed a treatment requiring an extensive stripping of the quadriceps and expansion to restore its sliding function rather than the rectus release of elongation. On the basis of the above two kinds of ideas, many improved surgery options were invented, and the principle of all of these surgeries was a minimally invasive approach. Since the 1980s, the arthroscopy technique has generally been applied to treat PTKS. In 2001, Rodriguez et al, reported quadriceps plasty under arthroscopy. Recently, they reported the results of a study of a combination minimally invasive surgery in treating PTKS.

Previous studies have found that the reasons for PTKS having had a relationship with original trauma degree were inappropriate initial treatment, unstable internal fixation, overlong external fixation, more than 3 months duration, site of fracture and a lack of standard rehabilitation. Therefore, to develop a treatment strategy for PTKS, a comprehensive assessment of the previously named factors should be considered. As clinical practice has showed, the patient's psychological, social, and economic factors need also to be taken into account.

Knee joint trauma or early rehabilitation therapy after surgery can effectively prevent the occurrence of knee joint dysfunction. Lindenfeld showed that the point at which posttraumatic rehabilitation started had associated with the curative effect. Yin held the view that 1 month after fracture is the optimal time for rehabilitation; the knee joint function can be basically returned to a normal state, but the effect of a delayed treatment later than 4 months is poor. Ke-min Liu et al found that when the clinical course is shorter than 3 months, the rehabilitation treatment curative effect is remarkable. In our study, the average knee joint ROM scoring increased 64 DHS in 28 of 63 patients, including 24 with intra-articular injury, 4 with femoral fracture (3 with external fixation, 1 with intramedullary fixation), the average duration is 2.5 months. In most of the cases, the extensor mechanism was not involved, even after femoral fractures, because at the method of external fixation and intramedullary pin fixation can only do slight damage to the extensor mechanism. Mandeep thought that if the duration is longer than 12 months, it is not amenable to rehabilitation treatment. In this paper, the course of 16 patients was longer than 12 months in the rehabilitation group. No significant difference was found on ROM score before or after treatment ($P > 0.05$), which corresponded with the literature.

The site of injury can also affect recovery. Cui, through analysis of the characteristics and rehabilitation efficacy of the distal femur, proximal tibia, and PTKS secondary to patella fracture, concluded that the effect of distal femoral fractures is poorer, while the effect of patellar fracture is optimal. In other words, the efficacy is related to whether the extensor mechanism is involved. Therefore, the authors think that when the patients have a course that is shorter than 3 months, no extensor mechanism is involved, there is a negative “end point sign” on physical examination, and a firm internal fixation without osteoporosis, rehabilitation therapy is preferred.

Less trauma, less pain, more accurate, high – security arthroscopy can help avoid injury of the cartilage, ligament, and meniscus efficiently when compared with traditional surgery. Joint activities can be limited by inside-the-knee joint fractures, hemorrhage, long-term immobilization, synovectomy, reconstruction after ligament injury, and even intra-articular adhesions after meniscectomy. Sprague et al, reported on 24 patients with knee stiffness treated by arthroscopy. In PTKS patients, ROM increased, on average, 45 DHS. Later, Lindenfeld et al, also reported a similar result. In 1997, Zhang reported 14 cases of PTKS resolved through arthroscopy.

The indication of the arthroscopy releasing surgery is intra-articular adhesion; when it is complicated with quadriceps adhesion, it should be supplemented with lysis plastic surgery. David pointed out that the anatomic and pathologic bases of knee joint stiffness should be fully recognized. Different parts of the adhesion cause different forms of rigidity, which should be gradually released in the surgery.

In this study, all patients in the arthroscopy group had intra-articular injuries, including 10 knee ligament injuries, 8 fractures of the tibial plateau, 4 femoral condyle fractures, and 2 femoral condyle fractures. The average duration was 6.3 months. The adhesion mainly was in the suprapatellar bursa, bilateral ditch, and condyle. After completion of intra-articular release, buckling the knee joint to check extra-articular structure is needed. If a positive “end point sign” is detected, combined minimally invasive therapy should be considered. Forceful releasing leads to intra-articular tissue tearing, and excessive stress in the joint space also tends to injure cartilage and ligament and even lead to fracture. Inappropriate releasing practices or passively flexing and training the knee joint can lead to a local complicated pain syndrome. At last follow-up, we found that after 6 months of continuous rehabilitation, ROM increased, on average, 15 – 20 DHS, which is better than intraoperative releasing in some patients. This result suggested that continuous rehabilitation training contributes to improved compliance of the muscles, tendons, fascia, and ligaments around the joint, findings that are identical to the research of Tang. Therefore, the authors think that patients with PTKS of 3–6 months duration, intra-articular adhesion without extensor mechanism involvement, a suspiciously

positive "end point sign," and unsatisfactory systemized rehabilitation treatment for a month are suitable for arthroscopy releasing.

In this study, most patients in the combined invasive group had femoral fracture or multiple injuries of the lower limbs; they were treated with open reduction and plate internal fixation accompanied by a severe intra-articular adhesion in the extensor mechanism. In addition, the involvement was generally classified into three types: (1) direct traumatic injury and/or intraoperative extensive dissection; (2) extensor mechanism contracture caused by knee joint dysfunction; and (3) a mixture of the first two.

The advantages of combined minimally invasive surgery are: (1) cut off part of the quadriceps conform to the opinions of minimally invasive surgery; (2) multiple zigzag extension with no sutures and early postoperative rehabilitation; and (3) no final hysteresis or affirmative effects. In this study, minimally invasive surgery is recommended when the course is within 3 to 6 months and the bilateral articular is involved. A positive "end point sign" indicates treatment by arthroscopy alone.

Because the pain directly affects early joint functional rehabilitation, the orthopaedic surgeon and anesthesia physician together provided safe and effective postoperative analgesia with peripheral nerve block catheters, especially continuous electrical stimulated localization on peripheral nerve block catheters. It has been given more and more importance because of its advantages. Ren reported a comparison of epidural analgesia and femoral nerve analgesia that suggested safe and effective femoral nerve block in postoperative analgesia of knee stiffness. In this study, femoral nerve catheters were generally kept in 5 to 7 days. The catheters were injected with a mixture of 10 ml 2% lidocaine and 10 ml 1% novocaine via catheter before training. More than 90% of the intraoperative maximum angle was tolerated by the patients' knee joints.

It also found that ROM declined after 3 weeks for half a year, especially in the morning in most patients. Some patients lasted 1 – 1.5 years, which suggests that it takes a long time to achieve postoperative compliance through long-term continuous rehabilitation. Some patients complained about the sensation of chill, numbness, and paresthesia in the knee joints, which deserves further research.

The Concept of Minimally Invasive Surgery and its Importance

Minimally invasive surgery should include rehabilitation, which is worth studying. Peter reported the applications of chronic static progressive stretch in the treatment of 41 patients with knee rigidity, which achieved a satisfactory curative effect. A threaded rod is needed when slowly doing a chronic static progressive stretch. When controlled by patients themselves, the muscles are totally relaxed and painless, with less injury to soft tissue around the joints. It keeps the soft tissue damage to a minimum in functional training and is easy to master. Japanese scholar Niwa Shigeo proposed the "medical stretching" concept, which is mainly aimed at 2 or 3 articular muscles, decreasing the antagonism of muscles and alleviating pain to reduce soft tissue injuries; posture and technique most often conforms to the principles of biomechanics. In addition, minimally invasive surgery should also be an integral part of rehabilitation therapy. Rosenberger stated that psychological factors are the key to the orthopaedic patients' recovery, in which the attitude and emotion are the strongest predictors. Most PTKS patients have a long average duration of pain treatment in many hospitals. Patients need an explanation of the treatment plan, the desired effect, the costs and the duration to ensure they understand the whole plan, the milestones, and that active participation and cooperation is crucial to successful treatment. Serious depression and suicidal ideation developed in 1 patient in our study, but consultation with a psychiatrist and psychologist helped alleviate the depression.

Each case of posttraumatic knee stiffness has different pathological features. Targeted individualized treatment strategies should be used to obtain a satisfactory curative effect. In this study, we concluded that when the patients comply with the following conditions, the course typically is less than 3 months, no knee extension device is needed. If there is a negative "end point sign" on physical examination and a firm internal fixation without osteoporosis, rehabilitation therapy is preferred. Patients with PTKS whose duration of rehabilitation is 3 – 6 months and have a negative "end point sign" and unsatisfactory systemized rehabilitation for 1 month are suitable for arthroscopic release. Minimally invasive surgery is recommended when the course is 3 – 6 months, the bilateral articular is involved, there is a positive "end point sign." Indistinctive treatment by arthroscopy alone (Figure 1).

Authors' Contribution

Sihai Liu is responsible for writing the paper; Kemin Liu and Aiqing Wang performed statistical analysis. Zhigang Cui collected the data; Xinzuo Han is responsible for the patients visiting and management; Fei Wang searched the references; Jianjun Li revised the paper.

REFERENCES

1. Bellemans J, Steenwerckx A, Brabants K, Victor J, Lammens J, Fabry G. The Judet quadricepsplasty: A retrospective analysis of 16 cases. Acta Orthopaedia Belgica, 1996 Jun; 62 (2): 79-82.
2. Bonutti PM, McGrath MS, Ulrich SD, McKenzie SA, Seyler TM, Mont MA. Static progressive stretch for the treatment of knee stiffness. The Knee, 2008 Aug 31; 15 (4): 272-6.

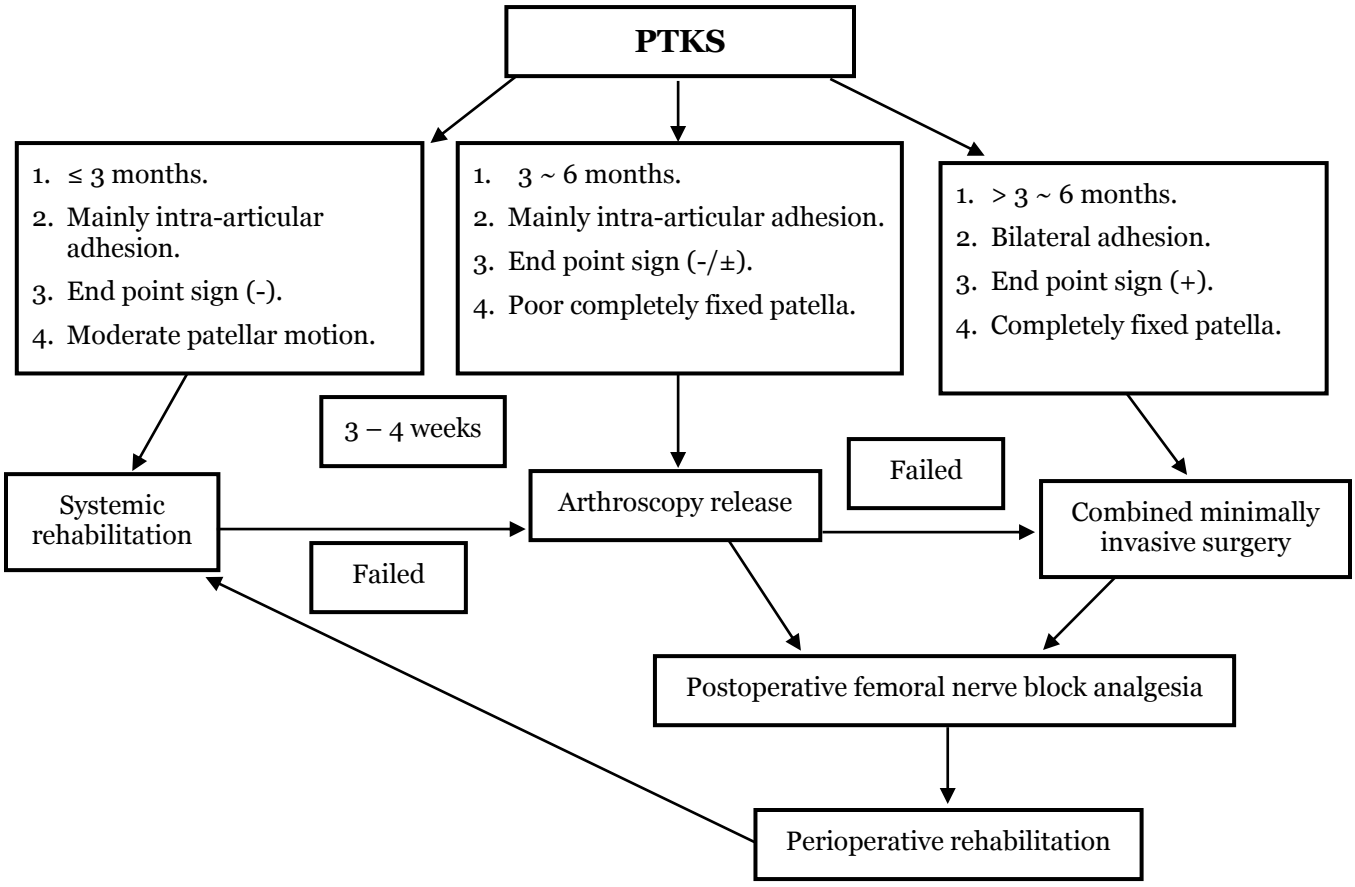

Figure 1: *Procedure of PTKS treatment strategy.*

Note: *Poor fracture healing, unstable internal fixation or severe osteoporosis should be firstly solved, and then enter the process.*

3. Cui ZG, Liu SH, Xue ZJ. The analysis of characteristics of knee stiffness caused by different parts of fractures around knee joint and early rehabilitation efficacy. Chin J Rehab Theory and Prac. 2010; 16: 1005-1007.
4. Insall JN, Ranawat CS, Aglietti P, Shine J. A comparison of four models of total knee – replacement prostheses. J Bone Joint Surg Am. 1976; 58 (6): 754-765.
5. Judet R. Mobilization of the stiff knee. J Bone Joint Surg. 1959; 41: 856-857.
6. Khakharia S, Fragomen AT, Rozbruch SR. Limited quadricepsplasty for contracture during femoral lengthening. Clin Orthop Relat Res. 2009 Nov 1; 467 (11): 2911-297.
7. Kim DH, Gill TJ, Millett PJ. Arthroscopic treatment of the arthrofibrotic knee. J Arthroscopic Related Surg. 2004; 20: 187-194.
8. Liu KM, Tang T, Wang AQ. The early clinical studies on post-traumatic treatment of knee dysfunction. Ortho J China, 2007; 15: 94-7.
9. Liu KM, Liu S, Cui Z, Han X, Tang T, Wang A. A less invasive procedure for post-traumatic knee stiffness. Arch Orthop Trauma Surg. 2011; 131: 797-802.
10. Liu KM, Tang T, Wang AQ. The present status and prospect of joint function rehabilitation. Orth J China, 2009; 17: 865-869.
11. Lindenfeld TN, Wojtys EM, Husain A. Operative treatment of arthrofibrosis of the knee. Instruc Course Lect. 2000; 49: 211-21.
12. Lindenfeld TN, Wojtys EM, Husain A. Instructional Course Lectures, the American Academy of Orthopaedic Surgeons – operative treatment of arthrofibrosis of the knee. J Bone Joint Surg Am. 1999; 81: 1772-84.
13. Lindenfeld TN, Bach BR Jr, Wojtys EM. Reflex sympathetic dystrophy and pain dysfunction in the low extremity. Instr Course Lect. 1997; 46: 261-8.
14. Mandeep S. Extra-articular arthroscopic release in post-traumatic stiff knees: a prospective study of endoscopic quadriceps and patellar release. Acta Orthop Belg. 2005; 71: 197-203.
15. Millett PJ, Williams RJ, Wickiewicz TL. Open debridement and soft tissue releases as a salvage procedure for the severely arthrofibrotic knee. Am J Sport Med. 1999; 27: 552-60.
16. Moore TJ, Harwin C, Green SA, Garland DE, Chandler RW. The results of quadricepsplasty on knee motion following femoral fractures. J Trauma. 1987; 27: 49-51.
17. Niwa J, Takayanagi F, Migawa H. The prevention of psoatic strain after lumbagos. Articular Surg. 2006; 25: 46-51.
18. Ren ZG, Wang Q, Wang ZC. The analgesic effects of femoral nerve block in the postoperative rehabilitation of knee releasing. Ortho J China, 2010; 16: 1176-1177.

19. Rodriguez Blanco CE, Leon HO, Guthrie TB. Endoscopic quadricepsplasty: a new surgical technique. Arthroscopy, 2001; 17 (5): 504-9.
20. Rosenberger PH, Jokl P, lckovics J. Psychosocial factor and surgical outcomes: an evidence – based literature review. K Am Acad Orthop Surg. 2006; 14 (7): 397-405.
21. Sprague NF, O'Connor RL, Fox JM. Arthroscopic treatment of postoperative knee fibroarthrosis. Clin Orthop. 1982: 166: 165-172.
22. Salter RB. History of rest and motion and the scientific basis for early continuous passive motion. Hand Clin. 1996; 12: 1-11.
23. Thompson TC. Quadricepsplasty to improve knee function. J Bone Joint Surg. 1944: 26: 366-379.
24. Tang WP, Zhang CL, Li MQ. "H" shaped releasing treatment of severe knee adhesion under arthroscopy. Chin J Bone and Joint Inj. 2003; 18: 521-523.
25. Yin Q, Wu JX, Liu HL. The analysis of curative effect of comprehensive rehabilitation treatment in knee dysfunction after fracture. Chin J Physical Medi and Rehab. 2004; 26: 304-306.
26. Zhang CL, Li MQ, Zeng ZX. Serious knee adhesion releasing under arthroscopy. Chin J Orthopaed. 2001; 16: 311-312.