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Progress in the treatment and prevention of knee intra-articular adhesion

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Abstract: Knee intra-articular adhesion has a serious impact on the postoperative patient ' s daily life, but the efficacy O F Traditional treatment is limited. To reduce knee intra-articular adhesion are the key to improve the expectations of surgery, which are an urgent problem to B E solved.

Objective: to analyze various articles concerning knee intra-articular adhesion, and summarize the The last decade, so as to provide new ideas and methods for the prevention of knee intra-articular.

METHODS: The The author retrieved PubMed database using computer and searched the relevant articles of the The "the" (2006) To 2016.

Keywords: were "tissue adhesions, arthrofibrosis, joint stiffness, prevent, treatment". Totally 1 articles were retrieved, and finally eligible articles were included in accordance with the inclusion CRI Teria.

RESULTS and conclusion: In recent years, a large number of scholars have found that trauma or surgery can cause knee joint bleeding and inflammation, which increased expression of vascular endothelial growth factor and interleukin-6, enhance th E activity of fibroblasts and secrete a large amount of collagen deposition, thereby causing knee intra-articular adhesion . The modification of traditional methods and application of minimally invasive technology have achieved a certain effect on The knee intra-articular adhesion, but there is still a risk for re-adhesion. A remarkable achievement has been obtained in the basic our T can become an effective to preventing intra-articular adhesion, but its clinical feasibility is still controvers Ial, and further investigation is needed to find drug possessing exact effect less and adverse reactions.

Subject headings: tissue adhesion; fibrosis; wound healing; Vascular endothelial growth Factors; Tissue Engineering

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introduction Introduction

Knee as the main weight-bearing joint , Because of a large activity and a lack of soft organization-protected and prone to injury and degenerative lesions , final surgery required cure . where knee adhesion is a common complication after surgery or trauma , to Key factors affecting surgical outcome , now the world's orthopedic problems one , often Cause limited joint activity , Chronic joint pain , final causes articular cartilage degenerative lesions and even stiffness

complications [1] . knee glue to total knee arthroplasty (Total knee Arthroplasty, TKA) Save after on 3. /. -10. /.

incidence , cruciate ligament reconstruction has 4. /. -35. /. send 2 rates [] . after study found patients ' preoperative condition , knee activity range , operation methods and quality and postoperative management and early rehabilitation plans are shadows The factor of knee joint adhesion [3],. Some scholars will post postoperative knee adhesion to the next bed and pathological features will be divided into 4 class : ① Knee has normal flexion feature , straighten restricted <10°; A single adhesion bundle appears on the patella upper SAC group woven , Front upper joint occasional discomfort , no other than typical Clinical manifestations ; ② knee with normal flexion function , straighten restricted > 10°; A small number of adhesion bundles clustered in the upper patellar sac ,clinical manifestations of knee Section front chronic pain ; ③ knee flexion restricted >30°, straighten restricted > 15°, Decreased patellar activity ; Large number of adhesions gather on the patellar sac , Shin Joint and knee front , Synovitis occurs , swelling and chronic pain , and so on ; ④ Knee flexion restricted >30° and <75°, straighten restricted >15°, patella activity disappears ; A large number of fibrous adhesion tissues are clustered in the knee joint outside , cause chronic joint pain , four head muscle atrophy , Stiff joint [4-5].

biomechanical Research and gait analysis Discovery , knee to patient daily Life has an extremely important effect , knee flexion to > 65° does not affect rows go ,>90°does not affect patients to sit down and stand up [6] . restores normal knee Activity range and alleviating joint chronic pain is treating knee joint

The primary purpose of adhesion [7] . currently more widely accepted treatment the main includes rehabilitation and surgical treatment . Although these methods are to some extent can improve symptoms , But its efficacy is currently not satisfying clinical needs [8]. in order to break through the treatment bottleneck of knee joint adhesion ,Broad scholar at prevention knee off section adhesion efforts , Especially in recent years have made a series of fruit , It provides a new idea and strategy for clinical prevention and treatment of knee joint adhesion . base on this , articles on the basic research of knee adhesion in the world in recent years Progress and prevention strategy make a systematic overview .

1. Data and methods Data and methods

1.1 Data source retrieved by the first author application computer PubMed number gallery (http :// www . NCBI . NLM . NIH . gov / PubMed /) Study the original With ,Overview , Review related documents , Search Time 2006 to 2016 year . retrieves the keyword "tissue adhesions, Arthrofibrosis, joint stiffness , Prevent , Treatment .

1.2 include and exclude criteria

level A To sign : ① related to the pathogenesis and prevention of tissue adhesion literature ② selection of the same domain recently or in authoritative magazinedocument .

Iris superscript : ① A repetitive study of research purposes ; ② Case Report and meeting papers ; ③ Statistical Method unscientific literature .

1.3 Document quality assessment and data extraction for a total of 1 503 Document , Filter literature by inclusion and exclusion criteria , all included The Article , including the pathogenesis of tissue adhesion , knee adhesion , fibrosis with and rigor treatment and prevention studies . on This basis the mechanism for knee joint adhesion What happens is , the progress of treatment and drug prevention is the na summary .

Restricted joints within range of activity

buckling restricted Knee sac adhesion ; lateral patellaı

support with fibrosis , patellar joint adhesion

straighten restricted posterior shortening of knee joint ; patellar lower sac , near the cruciate ligament , Shin Joint adhesion

2 Results Results

2.1 The main causes of adhesion of the knee joint caused by knee adhesion three-factor [3]: ① Pre-operative factors : Choice of operation Timing , Patient condition wait ,such as rheumatoid arthritis , ankylosing spondylitis and suppurative arthritis can cause joint capsular adhesion atrophy , limit joint activity range ; ② The factors : Operation ,Surgical Technology , Surgical quality and soft tissue injury degree Bleed volume and drainage etc ③

post-operative factor : Wound Care The rationality of anti-infective therapy and rehabilitation plan .

2.2 pathogenic mechanism of knee adhesion the main pathogenesis of knee adhesion system includes [9-1 0 : ① Trauma / Surgery causes early localized soft tissue haemorrhage , Activates inflammatory response , cause fibrin and inflammatory cell exudation ; ② with the balance of fibrinolytic and fibrinolytic systems is compromised ,Direct result in fibrin Deposition forms a temporary adhesion matrix , and to stimulate the surrounding fiber fine Cell Migration , multiplication and secretion of the original stock , The extracellular matrix of the adhesive protein , to form an overdose of inflammatory cells - shares original - fibrin complexes , with the micro Long entry of blood vessels , produces a lot of granulation tissue and gathers in synovial and joint around ; ③ Raw Fiber thickening , microvascular closure disappears , cause meat Bud Organization fibrosis , Synovial and articular capsule atrophy , lower articular cavity space and the secretion of hyaluronic acid , creates simultaneous joint adhesion became degenerative lesions of articular cartilage ; ④ late knee joint muscle group weaving shrinkage , The disuse of ligament shortening and stretching device , form becomes joint outer adhesion (See diagram 1).

2.3 Treatment for adhesion of the Knee Knee Range Limited including flexion and straighten restricted , caused by two factors inside and outside of the joint (See table 1). step

State Study analysis found , Buckling constraint is better than straighten restricted , Because of the latter to accelerate knee joint cartilage and femoral four-headed degenerative lesions [6]. where the knee is closed the early days of the first major manifestation of joint adhesion , outer articular appears late in surrounding organization adhesion , so early treatment of knee adhesion therapy , Manipulation and arthroscopic decompression under anesthesia ; late turn off four-head muscle arthroplasty for extensive adhesion outside the section . Rehabilitation treatment more often for early postoperative knee surgery to restore joint activity range and muscle strength ,, on formed knee joint , The effect is limited [one] . Some scholars have noted that , Manipulative decompression under anesthesia can effectively treat knee joint injury / after 8Week active less than 90° patients , Joint adhesion at this point in the early , Pine Soft tissue damage small space . Some scholars have studied the effect of manipulative decompression under anesthesia treatment of knee joint adhesion , The results indicate that the method is in the treatment of early knee joint adhesion with significant advantages [3 ,]. pariente wait [a] Report Benefits Manual decompression under anesthesia to treat knee joint adhesion , combined epidural Anesthesia Painless Rehabilitation Training , The results show the knee function , Pain Review Significantly improved compared to preoperative . Some scholars analyze total knee arthroplastypost -knee adhesion after treatment recommendations ,8 Week Anesthesia Method decompression treatment success rate , and 8 weeks to 6 months should be arthroscopic lax Solution , for the treatment of knee adhesion point to a clearer period of time [A] .

Although manipulative decompression under anesthesia has a certain effect on early knee adhesion effect , But its limitations limit its wide clinical application [a] . firstfirst ,, This operation cannot clear existing adhesions in the joint , affects soft Repair regeneration of the bones ; second , Postoperative pain and joint cavity hematoma cause the patient to deny early rehabilitation training , increased risk of adhesion ; third , under Anesthesia

There is still a dispute over the safety and long-term efficacy of manual decompression. .

with minimally invasive technology in the field of surgery , use arthroscopy to loosen the treatment of knee joint adhesion has gradually become the mainstream of the new Era . Surgical Trauma small , Joint Nesson full , Postoperative pain is lighter , facilitates early recovery For training [/]. Kim wait [[] using arthroscopic decompression for treatment Example Total knee replacement adhesion , postoperative knee function and pain score compared to preoperative Significant improvement , and average follow-up 1 after year found average knee flexion and Straighten angle increased 40.8° and 7.8° , Satisfactory clinical outcome . for patients with long history of adhesion , for merging joint external adhesion , simple joint The efficacy of the laparoscopic decompression is often questioned . Some scholars have improved the knee arthroscopy technique for femoral four head adhesion treatment , Loosen the articular adhesion through the patella The Upper arthroscopy entrance to the four-headed muscle under the microscope release , Early Postoperative rehabilitation training , The results showed that the modified technique was effective for the

treatment of some articular adhesion . Satisfaction [[] . Some scholars have studied arthroscopic decompression combined with hyaluronic acid , a clinical trial on the treatment of elbow adhesion with the injection , post- operative follow-up found elbow The node function and pain score were significantly improved compared with the control group. , once again after Operation The occurrence rate of the connection is significantly lower . This study is a New Way to prevent joint adhesion by using arthroscopic lysis and drug [?].

Although arthroscopic decompression is clinically widely used in the treatment of knee Joint adhesion , but still limited [] . first , indications narrower , for serious knee injuries , Joint gap stenosis and postoperative flap grafting are all contraindications to arthroscopic surgery ; Second , no improvement only Troubleshoot partial articular adhesion , for >1/2 femoral length four head muscle adhesion even difficult to achieve expected effect ; Third , Limited to the range of knee activity over 6 Month of patients treatment effect is not obvious [?].

Classic Thompson four-head muscle arthroplasty , Cut to the center of the knee Port , clear articular adhesion , separating the rectus and femoral muscles , clear Deep the mad Scar organization . Surgical Trauma Greater , pain severity , patients often reject the operation early functional exercise , increased anterior skin necrosis , Postoperative infection and then risk of adhesion [/]. Hahn etc [m] Use the improved Thompson stock Four-head [] - knee stiffness , Average follow-up 8 Year knee found section average activity range increased 70.2° , Research shows that this method is for The late adhesion of knee joint with extensive joint external adhesion can achieve clinical satisfactioneffect .

Judet four-head plasty by lateral femoral incision , Loose width The adhesion between the fascia lata and femoral four muscles , then detach from femur outside and middle muscles , Remove deep adhesion tissue . Oliveira wait [[] Report Way to judet femoral four-head muscle arthroplasty treatment a case Knee Joint extension contracture , The average flexion angle of the knee increases after the operation 71.4° , Clinical effect more satisfied . Lee wait [] Use improved Judet four-head musclearthroplasty Ilizarov external fixator treatment Ten Example knee Joint stiffness , results show that the party in the treatment of four muscle adhesion of the broad femoral head satisfactory and no activity Move range Bounce .

Although four-head muscle arthroplasty can be used to resolve adhesion inside and outside the joint , but surgery great trauma , pain Severe , affect functional training ,prone to knee flexion Appliance Damage , skin necrosis and infection , Postoperative adhesions and walking fatigue Postoperative complications , The surgical indications for this method in clinical practice are more than
is restricted .

2.4 Improved surgery and postoperative treatment to improve surgical outcomes and

Reduce the occurrence of adhesions , Some scholars have pointed out that , patients with knee injuries should do the To Avoid surgery in the acute phase of trauma , due to early inflammatory response and fiber The risk of postoperative adhesion is increased by () protein exudation . improved surgical options and techniques to reduce soft tissue damage , Rinse repeatedly to prevent foreign objects (Surgical Glove talc Pink , gauze) remaining strict hemostasis and drainage to prevent fibrin from sinkingproduct ["]. faldini wait [324 Research finds , after knee surgery 48-72 H to keep the flexion position reduce the amount of bleeding and increase the range of joint activity , at the same time stretch bandage pressure bandage , local ice compress , anti-infection therapy and Union town pain medications for early rehabilitation training can reduce adhesion risk .

2.5 prevention of knee adhesion in recent years how to prevent knee joint adhesion The occurrence has become the focus of a wide range of academics , by reducing the occurrence of adhesions rate to reduce the complications it causes , to increase surgical effectiveness and improve patient daily life . Current common methods are postoperative continuous passive movement and drugs prevent two kinds of [a] .

Some scholars have pointed out that , A continuous passive motion should be performed as early as possible after knee surgery Machine Training , joint through passive flexion and movement , accelerates local blood circulation , increase edema and fibrin absorption , for Active range Recovery [?]. Some scholars have probed into the application effect of continuous passive motion after knee surgery Fruit , found in knee function , pain score and length of hospital

stay The Continue passive motion group has a significant advantage , therefore, It is recommended that postoperative knee surgery should be done Early to develop continuous passive exercise rehabilitation training for optimal joint activity fan Surround [27-28] .

drug prevention of knee adhesion is widely studied in basic experiments , and Has achieved some results , but clinically on drug-related prevention of knee adhesion the Feasibility of the connection is still controversial , No clear guidelines appear , need further research [?]. Current prevention of postoperative adhesion of the knee joint of the drug large body can be divided into 4 class :

2.5.1 mechanical barrier drug hyaluronic acid by sliding film B cell and giant cell secretion , is an important part of articular fluid and articular cartilage , With with lubrication ,Nutrition and repair cartilage and resist infection , is wide for treatment and prevention of osteoarthritis [?]. Wang wait [[] the has Experimental Model study of knee joint braking in rabbits , Continuous 8 weekly intra-articular injection Hyaluronic Acid 0.3 mL, The results show that intra-articular injection of hyaluronic acid can reduce the The formation of articular adhesion tissues . Kanazawa etc [to] Transparent acid prevention of knee adhesion in rats , results show Hyaluronic acid Group the degree of adhesion to a sample , Inflammatory factors and stock levels were significantly lower than the Group by, The use of hyaluronic acid in the knee cavity can prevent postoperative knee surgery adhesion . Consider its mechanism to : ① mechanical barrier effect will fibrous tissue isolated from normal organization ; ② strong viscoelasticity and lubrication ,reduce fibrin composure ; ③ reducing soft tissue bleeding , swelling , Benefits early period Rehabilitation Training .

chitosan can reduce wound bleeding , inhibits fibroblast proliferation , Reduce the occurrence of fiber adhesion [/]. Carvalho etc [A] the reports the use of Shell Poly Basic Study on the prevention of epidural adhesion after rabbit laminectomy , after surgery 4 Weekly histological examination found that the number of fibroblasts in the operation area was significantly lower than that for

ng Tsunami , , and so on . Knee adhesion : new progress in treatment and prevention research nonporous

Group , indicates that chitosan can effectively prevent postoperative epidural adhesion .

2.5.2 anti-inflammatory drugs nonsteroidal anti-inflammatory drugs by inhibiting epoxidation enzyme activity lowers the synthesis of prostaglandins and plays an anti-inflammatory and analgesic effect Fruit , as anti-inflammatory analgesics widely used in clinic [+] . In recent years In-depth study found that non-steroid anti-inflammatory drugs by reducing vascular permeability ,, platelet aggregation and fibrinolytic enzyme activity resulting in adhesion The Acts . Sandova | etc [Study on the prevention of rabbit vertebral plate cut by diclofenac acid Experimental model for epidural fibrosis after surgery , results found in diclofenac Group samples in degree of fibrosis ,Fibroblast and inflammatory cell density on significantly superior to control group , The indicates that the drug is effective in suppressing inflammation Response and fibroblast activity to reduce epidural fibrosis . but non- the steroid anti-inflammatory drug has increased bleeding risk , Therefore, as an anti-adhesion drug The object is used in dispute .

steroid anti-inflammatory drugs reduce early trauma microvascular permeability , Fiber protein and inflammatory cell exudation , Mitigating inflammatory response and tissue edema ; suppresses Wound fibroblast proliferation , slow granulation tissue growth [+]. Scholars Prevention of epidural fibrosis after laminectomy in rats bydexamethasone Experimental Research , The results showed that dexamethasone inhibited the growth of vascular endothelial cells . Factor and its receptor 2 expression ,reducing fibrin and inflammatory cell infiltration , -fibroblast proliferation secretes extracellular matrix ability . But given the steroid anti-inflammatory drugs have immunosuppression , increase the risk of postoperative infection , because of the This is restricted clinically using as an anti-adhesion drug. [Panax] .

2.5.3 inhibition of fibrin deposition drugs there are studies indicating that , Fiber Egg White deposition plays a key role in the formation of adhesions. [38-39] . anticoagulantagent and plasminogen activator can prevent thrombin from forming and reducing fiber protein deposition . heparin , urokinase and recombinant tissue plasminogen activator The agent is widely reported as a drug in animal experiments that prevent adhesions. , The results show that it is effective to prevent adhesion. . But the above two types of drugs can be increased add postoperative bleeding risk , is clinically not

used as an anti-adhesion drug Apply report , extend restricted [?] .

2.5.4 Inhibits fibroblast- like drug mitomycin C is a head-shaped A antibiotic isolated from Streptomyces. , blocking tumor cells DNA replication for anti-tumor treatment [41]. In recent years some scholars have shredded the oxytetracycline C applied to anti-fibrosis treatment of refractory glaucoma after Operation , and Has a certain effect . [all]. kocaoglu wait [+] studied local joint apply mitomycin C Prevention of knee adhesion in rats , results show mitomycin C can effectively reduce the knee without compromising articular cartilage The occurrence of the node adhesion . Some scholars have different doses of mitomycin C for pre anti-Rabbit knee adhesion experimental study , results show 0.1 g/l mitomycin C Group samples in degree of adhesion , Joint range of activity and number of fibroblasts is significantly superior to other control groups [all]. Wangwait [[] will mitomycin C and Shell The preventive effect of dextran on knee joint adhesion in rabbits did a comparative study , Results Certificate Clear mitomycin C and Chitosan can prevent knee adhesion by inhibiting fibroblast proliferation and collagen deposition , but mitomycin effect fruit better . Clinical considerations to Mitomycin Coften as antitumor drugs make with and there is a risk of increased infection , therefore also need security and long Period Effect Analysis Research

All-trans-have acid is a vitamin A physiological metabolites of , has a wide Universal bioactivity , affect cell differentiation , multiplication , apoptosis and inflammation anti- should [all]. is widely used clinically for skin diseases and anti-tumor treatment [+]. the Research team conducted total trans-dimensional have acid in the prevention of rat epidural fibrosis Experimental studies , the results show that all-trans-dimensional have acid inhibits nuclear factors K B conduction pathway reduce interleukin 6 and Transformation growth factor p expression to reduce epidural fibrosis [[]. also , There are scholars reporting all-trans-have acid , can effectively inhibit bleomycin-induced pulmonary fibrosis in rats [a]. Wang wait [Wuyi] Experimental effect of total trans-dimensional have acid on preventing knee adhesion in rats Analysis , results found in total trans-have acid group in adhesion visual review points ,, The number of fibroblasts and inflammatory cells, and the expression of inflammatory factors. Water ping du is significantly better than the control Group , But the experiment does not explain the of all trans-retinoic acid have safe dosage and long-term effect , further research is needed in the future .

stating drugs (Statin) is optional Hmg-coa reductase suppression agents , clinically widely used to treat hyperlipidemia and prevent cardiovascular disease ill [+]. A recent in-depth study found that statins also have anti-inflammatory , anti-fiber The biological activities of dimensions and vascularization [53-54] . Wu etc [+] rosuvastatin Statin study on the prevention of adhesion of knee joint in rats , results show that rosuvastatin Statins by inhibiting vascular endothelial growth factor and interleukin 6 forexpression to reduce knee adhesion ; mg/kg rosuvastatin Group a sample of Hydroxyproline , fibroblast and inflammatory cell content significantly superior To other control groups . also , rosuvastatin can also be suppressed by inhibiting conversions long factor p and inflammatory factor expression to improve cyclosporine-induced rats renal fibrosis [a]. Park wait [+] contrasts lovastatin with mitomycin C Prevention of postoperative fibrosis of rabbit glaucoma , results indicate that lovastatin Anti-fibrosis effect is better than mitomycin C better . Some scholars have studied the effect of rosuvastatin on The prevention of epidural adhesion in rats and the methods of administration of the drugs by the way of "" " ,, results show total Medication Group prevention of epidural fibrosis most best [58-59]; The above experiments show that rosuvastatin can be used as a precaution against knee adhesion Even potential drugs , need further exploration .

3. discussion Discussion

Postoperative adhesion of the knee not only reduces surgical outcomes , causes knee joint function Missing and chronic joint pain , can also cause surgery to fail , brings the Patient a Huge physical and financial burden . today's prevention measures are mainly through the improvement of the hand technique , reduce organizational damage and bleed, etc. , but knee adhesion The incidence of is still high .. Traditional treatment for knee joint adhesion such as rehabilitation training , Manual Decompression under anesthesia , arthroscopic decompression and femoral four quadriceps into To some extent improve symptoms , But there is the possibility of adhesions , clinical effects

notsatisfactory. A large number of scholars study through the pathogenesis of adhesions system , from anti-inflammatory , anti-fibrin deposition and inhibition of fibroblast activity, etc. The method has achieved some success in basic research , But the drugs are unsafe and best dose research , And the method of administration and long-term curative effect still need to enter the a step further , The clinical expansion of has been limited to a certain extent . with human health The study of physical medicine steps from cell level to Gene level , some new targeting therapy , Nano carrier drugs and improved cytokines etc , on prevention knee adhesion or more potential . But these new means long term effect to

and clinical applications still lack further research , The human pair into fiber-fine cell gene levels and protein levels there are still a lot of gaps , future still need More scholars do further research .

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References

1. Bieger R, Kappe T, Fraitzl CR, *et al*. The aetiology of total knee arthroplasty failure influences the improvement in knee function. Arch orthop Trauma Surg 2013;133 (2): 237-241.
2. Faust I, Traut P, Nolting F, *et al* Human xylosyltransferases--mediators of arthrofibrosis? New pathomechanistic insights into arthrofibrotic remodeling after knee replacement. Sci Rep. 2015;5:12537.
3. mamarelis G, Sunil-kumar KH, Khanduja v. Timing of manipulation under anaesthesia for stiffness after total knee Arthroplasty. Ann transl Med. 2015;3:316.
4. Zhao S, Sun Y, Li X, *et al* reduction of intraarticular adhesion of knee by local application of rapamycin in RA Bbits via inhibition of fibroblast proliferation and collagen synthesis. J Orthop Surg Res. 2016; 19;11:45.
5. eckenrode BJ, Sennett BJ. Arthrofibrosis of the knee following anterior cruciate ligament. J orthop Sports phys ther. 2011;41 (1): the

6. Schiavone panni A, Cerciello S, Vasso M, *et al*. stiffness in total knee arthroplasty. J Orthop Traumatol. 2009;10 (3): 111-118.
7. Abdul N, Dixon D, Walker A, *et al* fibrosis is a common outcome following total knee. Sci Rep. 2015;5:16469.
8. Xu H, Ying J. A mini-invasive procedure for treating arthrofibrosis of the knee. Acta orthop traumatol Turc. 2016;13:30009-30008.
9. Mercer PF, Chambers RC. Coagulation and coagulation signalling in fibrosis. Biochim Biophys Acta. 2013;1832 (7): 1018-1027.
10. lieber RL, Ward SR. Cellular mechanisms of tissue fibrosis. 4.Structural and functional consequences of skeletal muscle fibrosis. Am J Physiol Cell Physiol 2013; 305 (3): c241-252.
11. Shukla H, Nair SR, Thkiaker D. Role Telerehabilitation in patients following total knee arthroplasty:evidenc E from a systematic literature review and meta-analysis. J telemed Telecare. 2016; pii:1357633x16628996.
12. Ipach I, Mittag F, Lahrmann J, *et al* arthrofibrosis after tka-influence factors on the absolute flexion and G Ain in flexion after manipulation under anaesthesia. BMC Musculoskelet Disord. 2011;12:184.
13. Issa K, Banerjee S, Kester MA, *et al*. The effect of timing of manipulation under anesthesia to improve range of motion and functional outcomes following total K Nee Arthroplasty. J Bone Joint Surg Am. 2014;96:1349-1357.
14. pariente GM, Lombardi AV Jr, Berend KR, *et al*. manipulation with prolonged epidural analgesia for treatment of KA complicated by Arthrofibrosis. Surg Technol Int. 2006; 5:221-224.