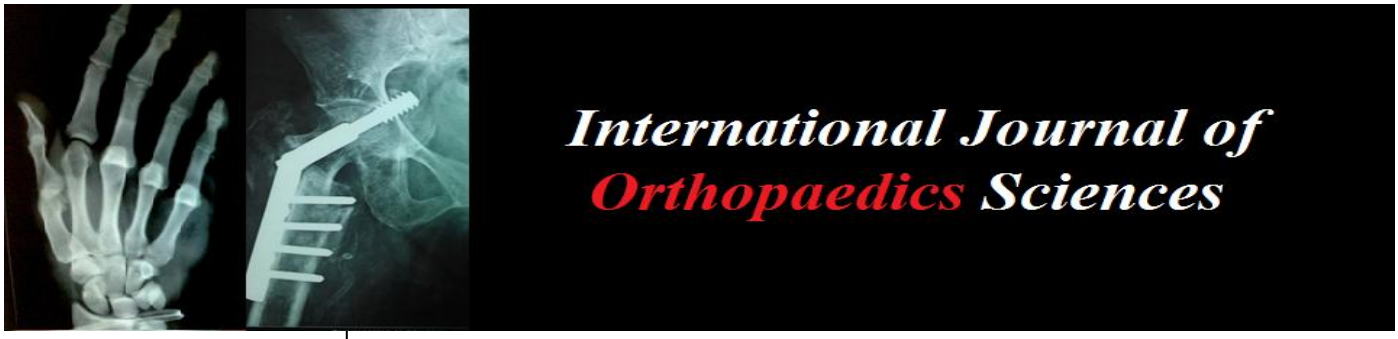

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Dr. B Subodh Shetty
Professor, Department of Orthopaedics, J.J.M Medical College, Davangere, Karnataka, India

Dr. Powdhan HP
Professor, Department of Orthopaedics, J.J.M Medical College, Davangere, Karnataka, India

Dr. Harsh K Rao
Junior Resident, Department of Orthopaedics, J.J.M Medical College, Davangere, Karnataka, India

Corresponding Author:
Dr. B Subodh Shetty
Professor, Department of Orthopaedics, J.J.M Medical College, Davangere, Karnataka, India

A study of functional outcome in patients undergoing arthroscopic reconstruction of anterior cruciate ligament injury using hamstring tendon graft with interference screws

Dr. B Subodh Shetty, Dr. Powdhan HP and Dr. Harsh K Rao

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Abstract
The Anterior Cruciate Ligament is the primary stabilizer of the knee and prevents the knee against anterior translation. It is also important in counteracting the rotational and valgus stress. The arthroscopically aided approach has the advantages of smaller skin and capsular incisions, improved viewing of the intercondylar notch for placement of the tunnel and attachment sites, less postoperative pain, fewer adhesions, earlier motion and easier rehabilitation.
Approximately 100,000 anterior cruciate ligament (ACL) reconstructions are performed in the USA each year. Interference screw fixation is considered the standard for rigid fixation of the graft and provides higher fixation strength compared with other devices such as staples or buttons.
Most studies showed no intergroup difference in terms of outcomes measured with validated clinical scores such as IKDC (International Knee Documentation Committee), Lysholm score and Tegner activity level. There was no significant difference regarding range of motion. Knee stability as evaluated with pivot shift and KT arthrometer showed a significant difference only in one study, favouring metallic interference screws.
Materials and Methods: Patients admitted to CG hospital and Bapuji hospital in Davangere, Karnataka between 2019 October to 2021 October were taken into the study after taking informed consent.
Results: This study consists of 25 cases of Anterior Cruciate Ligament injury. All cases were performed arthroscopically. ACL rupture was common in second and third decade. In our study, male preponderance was found with 23 (92%) and female preponderance of 2 (8%). Side affected was 13 (52%) right side and 12 (48%) left side. Mode of injury in the present study includes various sources such as sports, RTA, fall. Results were evaluated by using International Knee Documentation committee (IKDC) and Lysholm knee scoring scale. In present study we have 22 patients with Excellent results, 2 cases as Good, 1 case as Fair and 0 cases as Poor. No case needed re-surgery. In the present study there were no cases of superficial infection.
Conclusion: Arthroscopic reconstruction of ACL using Semitendinous and Gracilis tendon graft (Hamstring tendon) with Interference screws can be considered the best mode of treatment for ACL rupture.

Keywords: Arthroscopy, anterior cruciate ligament, semitendinous muscle, gracilis muscle, international knee documentation committee (IKDC) and lysholm knee scoring scale

Introduction
Ruptures of the anterior cruciate ligament of the knee have incidences of 124 to 0.34 per 1000 population every year [2]. These injuries are devastating, not only at the time of the acute injury, but also as patients who sustain an ACL tear have a 78% risk of radiographic osteoarthritis within only 14 years following their injury, whether they undergo surgical reconstruction or not [3]. For a high school or college student with an ACL tear, that is a striking and troubling statistic.
The anterior cruciate ligament is essential in restraining the anterior translation of the tibia over the femur and provides rotational stability of the joint.

ACL lesions usually occur as a result of a particular pattern of movement, most commonly when a sudden force (i.e. external impact, landing on feet etc.) acts on a straight knee with firmly planted feet causing the knee to go through a valgus motion with an associated internal rotation. ACL lesions can be functionally disabling and predispose to further injury, and also promotes early onset of degenerative articular changes [4, 5]. After an ACL rupture, recurring episodes of joint instability ('giving way') are associated with meniscal injury, articular cartilage damage and abnormal osseous metabolism [4, 6-8].

The first ACL graft fixation using interference screws, as early as 1983, was achieved using a metallic device, obtaining good results [9]. At present, Titanium is the most common material used for this class of devices. Titanium screws provide high initial fixation strength and promote early integration into the bone.

Hewett TT *et al*. Ligament reconstruction is the current standard of care for active patients with an anterior cruciate ligament (ACL) rupture. Although the majority of ACL reconstruction (ACLR) surgeries successfully restore the mechanical stability of the injured knee, post-surgical outcomes remain widely varied. Less than half of athletes who undergo ACL reconstruction return to sports within the first year after surgery, and it is estimated that approximately 1 in 4 to 1 in 5 young, active athletes who undergo ACL reconstruction will go on to a second knee injury. The outcomes after a second knee injury and surgery are significantly less favorable than outcomes after primary injuries [10].

AHN J H Reconstruction of the ACL by use of preservation and femoral tensioning of the remnant tissue showed good clinical results without increased concerns regarding incorrect tunnel formation.

De Jongsn *et al*. data suggest that quadriceps strength deficit is related to the ACL injury and is increased by ACL reconstruction. Flexion strength is within the normal range before and after surgery. These results are influenced by graft choice, with a higher quadriceps strength deficit for BPTB grafts. STG grafts induce a higher hamstring strength deficit compared with BPTB grafts. Functional assessment is improved at 9 and 12 months post-operatively compared with pre-operatively. However, an increased pre-operative quadriceps strength deficit results in a lower limb symmetry index at 6 and 9 months post-operatively [11].

Nikolaus a Streich data suggest that ACL Reconstruction using double- bundle technique is advocated to more closely restore the anatomy and function of the native ligament than conventional single-bundle technique. However, the anterior and rotational stability improved significantly compared to pre-operatively in both the techniques. The statistical analysis showed a significant increase for the IKDC score and the Lysholm score at final follow-up among each single technique, while there was no significant difference between the two reconstruction methods [12].

Materials and Methods

Source of Data

The study will be conducted on patients of both sexes with ACL injury in the Orthopaedics Department of Bapuji Hospital and Chitageri General hospital attached to Jagadguru Jayadeva Murugarajendra Medical College, Davangere during the study period of 2019 October to 2021 October.

Method of collection of Data (including sampling procedures if any): Collection of data of patients presenting with anterior cruciate ligament injuries are as follows.

- History.
- Clinical examination both local and systemic.
- Radiological examination with routine other imaging modalities.
- Investigations - which are necessary for anaesthetic fitness.
- Knee anatomy assessed with MRI.
- Diagnosis - Clinical and radiological.
- Surgery - Arthroscopic ACL reconstruction Sample size: 25 patients.

Study design: It is a prospective study. Sampling technique: All cases of ACL injury.

Study population: Patients with ACL tear coming to Orthopaedic Department of Jagadguru Jayadeva Murugarajendra Medical College, Davangere, India.

Clinical examination immediately before surgery and post-operatively at 15 days, 1 month, 6 weeks, 3 months and 6 months intervals regarding pain, knee stability, knee range of motions.

Inclusion Criteria

1. Age 20 to 55 years.
2. ACL injury with or without meniscal injury.
3. Associated with symptoms of instability.

Exclusion Criteria

1. ACL avulsion fractures and multi ligament injuries.
2. Fractures in the ipsilateral or contralateral limb.
3. Revision ACL surgery.
4. Contralateral ACL injury.

Operative procedure

Position: Patient kept in supine position with the operating knee flexed to 60-70 degrees with the help of a bolster and a thigh support in order to provide better stability.

Operating procedure

Graft harvest: Make a 4-cm incision anteromedially on the tibia starting approximately 4 cm distal to the joint line and 3 cm medial to the tibial tuberosity. Expose the Pes anserinus insertion with subcutaneous dissection. Palpate the upper and lower borders of the Sartorius tendon and identify the palpable Gracilis and Semitendinosus tendons 3 cm to 4 cm medial to the tendinous insertion. Make a short incision in line with the upper border of the gracilis tendon and carry the incision just through the first layer, taking care not to injure the underlying medial collateral ligament. With Metzenbaum scissors, carry the dissection proximally up the thigh. Stay in the same plane and maintain adequate exposure by using properly placed retractors. Careful observation of structures is necessary to avoid injuring the saphenous vein or nerve. With a curved haemostat, dissect the gracilis and semitendinosus tendons from the surrounding soft tissues about 3 cm medial to their insertion onto the tibia. After carefully identifying each tendon, sub- periosteally dissect the tendons medially to the insertion and release them sharply. Place a non-absorbable Krackow stitch on the tendon ends using different colored sutures to differentiate the two tendons. Palpate all sides of the tendon to ensure there are no fibrous extensions before releasing it with an open-end tendon stripper. Release the tendon proximally by controlled tension on the tendon, while

advancing the stripper proximally. The muscle should slide off the tendon as the stripper is advanced proximally. Use the same procedure to release the semitendinosus tendon. At a separate table, separate the muscle from the tendon with a No. 10 blade. Place a Krackow-type whipstitch in both ends of each tendon with No. 5 Ethibond sutures. Fold both tendons in half to form four strands of tendon. Preserve the harvested tendons in a gentamycin soaked guaze.

Femoral tunnel preparation

To perform a femoral tunnel placement a guide is placed to ensure that the tunnel is just anterior to the anteromedial bundle; ie, leaving a 2 mm posterior wall and about 5 mm from the femoral articular surface. Flex the knee 120 degrees and use a flat-blade reamer to avoid articular damage and to allow optimal visualization of tunnel placement. Advance the reamer 1 mm and recheck the tunnel location. If it is in the desired location, ream a 30 mm tunnel ideally. Carefully retract the reamer and remove it from the joint, being careful not to enlarge the tunnel and ream out the posterior wall of the femur.

Tibial tunnel preparation

Tibial tunnel will need to be placed at a 55 degree sagittal angle just lateral to the medial collateral ligament. This does allow for a longer tibial tunnel. When placing the tibial guide intraarticularly, be aware of the intended tunnel length and direction so that the graft can be secured in an anatomic, impingement free position. Proper length and direction of the tunnel require a starting point approximately 1 cm proximal to the pes anserinus and about 1.5 cm medial to the tibial tuberosity to form a 30 to 40 degree angle with the shaft of the tibia. One should see this wire being directed to approach the femoral pilot hole. Intraarticular reference points that can serve as guides include the anterior cruciate ligament stump, the inner edge of the anterior horn of the lateral meniscus, the medial tibial spine, and the posterior cruciate ligament. This point should be approximately 7 mm anterior to the posterior cruciate ligament and 2 to 3 mm anterior to the peak of the medial spine at the center of the anterior cruciate ligament footprint. In the mediolateral plane, ensure that the wire enters at the base of the medial spine or just slightly medial to the center of the anterior cruciate ligament footprint. Using the guide at 55 to 60 degrees to the tibial plateau surface helps to obtain a sufficient tunnel length and an angle that allows the graft angle to approximate that of the original. The tunnel is reamed 2 mm smaller than the graft size and serially dilated to produce a snug fit. The tunnel length should be 30 to 35 mm to allow fixation near the articular surface. A composite screw 1 mm smaller than the tunnel for tibial fixation is used.

Graft passage

Use the eyelet guide wire to pass a suture loop with tails through the femoral tunnel and out through the lateral thigh. Retrieve the loop through the femoral tunnel. Use this loop to pass the graft up through the tibial tunnel and then guide it into the femoral tunnel using a probe. The cancellous surface of the femoral bone plug is positioned to face anteriorly.

When the graft is in the femoral tunnel, pass a flexible guide wire through the medial portal, and with the wire parallel to the graft, advance both up into the tunnel. Ensure that at least 2 cm of bone plug remains in the tibial tunnel for later fixation; if necessary, recess the graft into the femoral tunnel and choose a longer interference screw to fix the graft at the femoral aperture.

Graft fixation: Secure the graft with an interference screw with a sheath passed through the low medial portal to form a straight line with the tunnel. The screw should firmly engage the bone and be flush with the femoral aperture. Move the knee through a range of motion while holding tension distally on the graft. Secure the graft to the tibial end with a screw equal to the gap size plus 5 mm with the knee in full extension. Move the knee through a full range of motion and ensure there is no evidence of capture of the knee joint. Observe and probe the graft arthroscopically to ensure that it is taut. The graft should be slightly tighter than a normal anterior cruciate ligament. Also ensure that there is no impingement and that no bone or screw protrudes into the joint from the tibial or femoral tunnel. Check the stability of the knee by Lachman and Pivot shift maneuvers. The knee should be just slightly tighter than the uninjured knee.

Subcutaneous and skin sutures placed. Sterile dressing done. Long knee brace applied with limb elevation before shifting to the post-op wards for further management.

Physiotherapy

A long knee brace was applied post operatively till knee range of motion exercises were initiated. Patients were encouraged to perform active straight leg raising, knee flexion of 30 degrees and quadriceps muscle strengthening exercises from post-op day 1. These isotonic exercises are very much essential for the excellent outcome. Assisted walking with help of walker was encouraged from post-op day 3 untill next follow up. Complete weight bearing was encouraged after 4 to 6 weeks. Cycling and squatting was advised after 2-3 months. Sports activities were initiated after a period of 6 months.

Results

The present study consists of 25 cases of arthroscopic reconstruction of anterior cruciate ligament rupture using Hamstring tendon graft and Interference screws. The study period was from October 2019 to October 2021.

Table 1: Age distribution

AGE (Years)	No. of patients	%
20-25	1	4%
26-35	13	52%
36-45	10	40%
46-55	1	4%
Total	25	100%

Table 2: Sex distribution

Sex	NO. Of Patients	%
Male	23	92%
Female	2	8%
Total	25	100%

Table 3: Side affected

Side affected	NO. of Patients	%
Right	13	52%
Left	12	48%
Total	25	100%

Table 4: Mode of injury

Mode of injury	NO. of Patients	%
Sports	15	60%
Rta	6	24%
Self-fall	4	16%
Total	25	100%

Table 5: Complications

Complications	NO of patients	%
Knee stiffness	1	4%
Infection	NIL	NIL

Criteria for evaluation of result

Table 6: Lysholm knee score

Factors	Scoring out of	Average scores
Pain	25	20
Limp	5	5
Support	5	5
Instability	25	25
Locking	15	15
Swelling	10	10
Stair climbing	10	10
Squatting	5	4

The Lysholm Knee Score is an 8 item questionnaire originally designed as an outcome measure for ligament reconstruction. Eight factors are rated to produce an overall score on a point scale of 0 to 100. Then an assignment is given as "Excellent" for 95 to 100 points; "Good" for 84 to 94 points, "Fair" for 65 to 83 points, or "Poor" for less than 65 points. The factors of limp, support, and locking are worth a potential of 23 points; pain and instability, 25 points each; swelling and stair climbing, 10 points each; and squatting, 5 points. The symptoms of pain, swelling, and instability are graded according to the activity in which they occur. In our study, out of 25 patients, 22 patients achieved an Excellent score, 2 patients achieved a Good score and 1 patient achieved a Fair score.

Table 7: Post-operative knee flexion (6 months)

Knee flexion	NO of Cases	%
0-120 degrees	1	4%
0-130 degrees	1	4%
0-140 degrees	23	92%
Total	25	100%

Table 8: Functional results

Results	No of cases	%
Excellent	22	88%
Good	2	8%
Fair	1	4%
Poor	Nil	Nil
Total	25	100%

Table 9: IKDC subjective score

	Pre-op Mean (standard deviation)	Post-op Mean (standard deviation)	p-value
IKDC subjective score	50.86 (10.45)	87.66(6.98)	0.00001

The mean pre-op IKDC subjective score was 50.86 while the mean post-op score was 87.66. There was significant improvement in post-op IKDC score when compared with pre-op score (p<0.05).

Case illustrations

Case 1

Fig 1: Pre-op MRI showing ACL tear with intact PCL in sagittal section

Fig 2: Post-op X–ray showing interference screws used for graft fixation on the tibial and femoral bones

Fig 3: Clinical picture showing full range of knee movement without extension lag at18 months follow up

Fig 4: Clinical pictures showing the patient doing complete knee extension with squatting at 18 months follow up

Case 2

Fig 5: Pre-op MRI showing ACL deficient knee in sagittal section

Fig 6: Post-op X–ray showing interference screw used for graft fixation on the femoral side and the tibial side

Fig 7: Clinical picture showing painless full range of knee movements without extension lag at 1 year follow up

Fig 8: Clinical pictures showing the patients ability to extend his knees and squat at 1 year of follow up.

Case 3

Fig 9: Pre-op MRI showing ACL tear with intact PCL in the sagittal section

Fig 10: Post-op X–ray showing Interference screws used for graft fixation on the tibial and femoral sides

Fig 11: Clinical picture showing painless full range of knee movements without extension lag at 1 year follow up

Fig 12: Clinical pictures showing the patients ability to extend his knees and squat at 1 year of follow up

Discussion

Anterior cruciate ligament ruptures are relatively common injuries which can challenge the treating physician. The ACL has poor potential for spontaneous healing when it is completely torn. Two third of patients develops knee instability following injury to ACL. Success of the ACL reconstruction depends on proper anatomic placement of the femoral and tibial tunnels. Regarding ACL reconstruction, consistent and accurate tunnel placement is crucial to avoid complications because small changes in tunnel position can affect the knee stability and outcomes [13, 14]. Surgical reconstruction is the gold standard for the treatment of ACL injury in sportsman and young individual in achieving high rate of success in terms of recovery of normal knee function and return of pre injury level of activity [15, 16].

The use of the semitendinosus and gracilis (STG) tendons is becoming the choice in anterior cruciate ligament (ACL) reconstruction. This graft has the advantage of having a mechanical resistance theoretically superior to the mechanical resistance of a tendon from the patellar ligament with a minimum width of 8.5 mm, having a minimum of iatrogenic complications, preserving the extensor apparatus and thus reducing anterior knee pain.

Semitendinosus and gracilis tendon has less donor site morbidity compared to BPTB graft. There is conventional single bundle reconstruction technique which involves placing single bundle of graft in a tunnel whereas double bundle reconstruction involves two graft bundle in separate tunnel and is considered more anatomical [17].

Conclusion

Today, this study included 25 patients and is a prospective study reporting the clinical and radiological results, with a 1.5 years minimum and 2 years maximum follow-up, of an ACL reconstruction technique using hamstring tendons attached to the femur and tibia with interference screws, with an objective IKDC score of 88% Excellent, 8% Good and 4% Fair results. Successful ACL reconstruction depends on a number of factors: patient selection, surgical technique, including graft choice and management of associated meniscal and ligament lesions, and postoperative rehabilitation. Donor-site morbidity and especially risk of anterior pain and discomfort kneeling are less with Hamstring tendon graft.

The absence of patellofemoral pain with the use of hamstring graft makes it a more desirable option for patients with patellofemoral cartilage disorders or those with chronic patellofemoral pain.

From this study, we conclude that anterior cruciate ligament injuries are common in younger age group individuals. Sports related injury and RTA are the most common modes of injury. Arthroscopy assisted ACL reconstruction using hamstring tendon autograft provides a stable knee, reduces postoperative morbidity and enables early rehabilitation. Graft fixation using interference screw will help the graft to facilitate graft tunnel healing and also maintain its strength until there is a good graft to bone healing occurs. The functional outcome is excellent to good and allows the patients to return to pre-injury level of activity, allows the patient to squat, sit crossed leg and climb stairs without difficulty with the hamstring muscle graft. Arthroscopy assisted ACL reconstruction with quadrupled hamstring tendon autograft using interference screw is an excellent treatment option for anterior cruciate ligament deficient knees.

Arthroscopic ACL reconstruction with autogenous hamstring graft is an excellent procedure. High success rate has been achieved after this procedure with regard to functional recovery of patients.

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Author's Contribution

Not available

Conflict of Interest

Not available

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References

1. Terry Canale S, James Beay H. Arthroscopy of the lower extremity: Campbells operative Orthopaedics, 11th edition, 2855-2856.
2. Matjaz Sajovic. Simultaneous Bilateral Anterior Cruciate Ligament (ACL) Reconstruction with use of Hamstring Tendon Autografts: a case Report. Journal of Surgery. 2013;1(1):1-5.
3. Ardern CL, Taylor NF, Feller JA, *et al*. Fifty-five per cent return to competitive sport following anterior cruciate ligament reconstruction surgery: an updated systematic review and meta-analysis including aspects of physical functioning and contextual factors. Br J Sports Med. 2014.
4. Andersson D, Samuelsson K, Karlsson J. Treatment of anterior cruciate ligament injuries with special reference to surgical technique and rehabilitation: an assessment of randomized controlled trials. Arthroscopy. 2009;25:653–85.
5. Maffulli N, Osti L. ACL stability, function, and arthritis: what have we been missing? Orthopedics. 2013;36:90–2.
6. Dhillon MS, Ball K, Prabhakar S. Differences among mechanoreceptors in healthy and injured anterior cruciate ligaments and their clinical importance. Muscles Ligaments Tendon J. 2012;2:5.
7. Maffulli N, Binfield PM, King JB. Articular cartilage lesions in the symptomatic anterior cruciate ligament deficient knee. Arthroscopy. 2003;19:685–90.
8. Van der Hart CP, van den Bekerom MPJ, Patt TW. The occurrence of osteoarthritis at a minimum of ten years after reconstruction of the anterior cruciate ligament.
9. J Orthop Surg Res. 2008;3:9.
10. Lambert KL. Vascularized patellar tendon graft with

rigid internal fixation for anterior cruciate ligament insufficiency. Clin Orthop Relat Res. 1983;85–9.
11. Hewett TE, Di Stasi SL, Myer GD. Current concepts for injury prevention in athletes after anterior cruciate ligament reconstruction. Am J Sports Med. 2013;41:216–224.
12. de Jong SN, van Caspel DR, van Haeff MJ, *et al*. Functional assessment and muscle strength before and after reconstruction of chronic anterior cruciate ligament lesions. Arthroscopy. 2007; 23:21–8.28.
13. Nikolaus A Streich, Kilian Friedrich, Tobias Gotterbarm, Holger Schmitt. Knee Surgery, Sports Traumatology, Arthroscopy. 2008;16(3):232-238.
14. Morgan JA, Dahm D, Levy B, Stuart MJ. MARS Study Group. Femoral tunnel malposition in ACL revision reconstruction. J Knee Surg. 2012;25:361-368.
15. MARS Group, Wright RW, Huston LJ. Descriptive epidemiology of the Multicenter ACL Revision Study (MARS) cohort. Am J Sports Med. 2010;38:1979-1986.
16. Francesco. Cruciate ligament reconstruction and rehabilitation: predictors of functional outcome. Joints 2015, 3(4).
17. A'lmeida A. Evaluation of the results of arthroscopic acl reconstruction with autogenous flexor tendons. Revista Brasileira de Ortopedia. 2010;45:4.
18. Morey VM, Nag HL, Chowdhury B, Sankineani SR, Naranje SM. A prospective comparative study of clinical and functional outcomes between anatomic double bundle and single bundle hamstring grafts for arthroscopic anterior cruciate ligament reconstruction. International Journal of Surgery. 2015;21:162-167.

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