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RESEARCH ARTICLE

OBSERVATIONS ON ARTHROSCOPIC TRANS-PORTAL SINGLE BUNDLE QUADRUPLED HAMSTRING AUTO GRAFT RECONSTRUCTION WITH APERTURE FIXATION FOR COMPLETE ACL DISRUPTION

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ABSTRACT

Aims and Objectives: to observe and evaluate the efficacy of aperture fixation for complete ACL rupture by arthroscopic tans-portal single bundle quadrupled hamstring auto graft reconstruction. **Materials and Methods:** Quadrupled hamstring auto graft prepared was secured using femoral interference screw via the anteromedial port with knee in hyperflexion to ensure absolutely parallel screw placement. Tibial interference screw was placed with knee in full extension and graft under longitudinal traction to prevent proximal migration during screw advancement.
Results: The Lysholm functional score improved from a mean pre-operative value of 55.23 (range 36 – 77) to 89.88 at six months (76-96) and improved to 93.8(range 80 – 98) at final follow up. The Tegner activity level improved from a mean pre-operative value (post injury) of 3.13 (range 2 – 4) to mean postoperative value of 5.13 at six months to 6.3 (range 4 – 8) at final follow up. The single leg hop test measurements improved from a mean preoperative value of 57.2% (range 40 – 71) to 86.76 at six months and 90.5 (range 79 – 98) at final follow up assessment.
Discussion and Conclusion: ACL reconstruction using quadrupled hamstring auto graft and interference screw fixation is safe and highly successful with very few complications. Accelerated rehabilitation is possible in view of strong fixation of graft using interference screws.

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INTRODUCTION

With the rise of participation in sports the incidence of ACL injury in the general population has increased (Arbes *et al*., 2007). Most diagnosed ACL injuries are complete disruptions (85%), and partial sprains occur less frequently (15%) mostly occurring in combination (75%) with injury to other structures in the knee joint, including meniscus, articular cartilage, collateral ligament, or joint capsule. The development of symptomatic knee instability after ACL injury ranges from 16% to almost 100%. Repeated episodes of subluxation in the ACL- deficient knee can result in further intra-articular damage. Meniscus injury occurs in association with 50% of acute ACL tears, and this figure rises to 90% in ACL-deficient knees assessed 10 years or more after the initial injury. The incidence of articular cartilage lesions rises from 30% in acute ACL injuries to approximately 70% of knees with chronic ACL instability. The progression to radiographically detected osteoarthritis in ACL-deficient knees is variable, ranging from 15% to 65%, and it depends on the length of follow-up. Without treatment, a complete ACL injury can result in progressively increasing symptomatic knee instability, which inflicts recurrent intra-articular damage and eventually causes osteoarthritis (Getelman *et al*., 1999; Neill *et al*., 1996). Current indications for ACL reconstruction include young age, high- risk life style including heavy work, sports, or recreational activities, repeated episodes of giving way in spite of rehabilitation (Beynnon *et al*., 2005). Several different fixation methods are currently available. Interference screws have been successful with grafts with a bone block at the end. This type of fixation can be at the articular surface (aperture fixation), and can thus limit the graft-tunnel motion (Woo *et al*., 2006). Interference screws have also been used with soft tissue grafts with good results. Bio-absorbable and metal screws have generally provided comparable initial fixation strengths in cyclic loading tests (Kousa *et al*., 2003). Suspensory fixation (e.g. endobuttons, transfixion) fixes the

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graft further from the joint and thus allows graft-tunnel motion to occur. For the tibial side, cortical or interference screws, washers etc. have been used (Kousa *et al*., 2003). Bone tunnel enlargement after ACL reconstruction occurs within the first months, and according to the study of Peyrache *et al*. (1996) the tunnel diameter decreases after 3 years when using a BTB graft with an interference screw fixation. This phenomenon seems to be related to the surgical technique (Giron *et al*., 2005; L'Insalata *et al*., 1997). So far, it has not been associated with increased laxity or graft failure (Aglietti *et al*., 1998; Clatworthy *et al*., 1994). Tunnel lysis or expansion may be clinically significant in revision surgery because the enlarged tunnels may complicate graft placement and fixation (Wilson *et al*., 2004). The etiology of tunnel enlargement is most likely mechanical and biological factors.Possible contributing factors to tunnel widening include graft-tunnel motion, synovial inflammatory response, localized bone necrosis caused by drilling, accelerated rehabilitation, use of allograft tissue, and malpositioning of the tibial tunnel (Wilson *et al*., 2004; Hoher *et al*., 1998). The interference screw fixation does not allow graft-tunnel motion. With the BTB autograft placing the bone block close to the joint line results in minimal tunnel widening (Aglietti *et al*., 1998). Similarly with the hamstring graft, a correlation between the incidence of tibial tunnel widening and the distance of the interference screw from the joint line was reported, so that the incidence of widening was smallest when the screw was closest to the joint (Giron *et al*., 2005). The extent of tunnel widening with bio-absorbable interference screws depends also on the screw material used (Robinson *et al*., 2006). Reported success rate of primary ACL reconstruction is 75 - 97%. Therefore, a significant number of patients who undergo ACL reconstruction require a revision.

MATERIALS AND METHODS

Under anesthesia physical examination was performed. Torniquette was applied and limb painted and draped. A diagonostic evaluation was performed first. Hamstring graft harvested and preferared using quadrupled. General principles of Transportal technique included a low medial portal, marking the Centrum of the femoral tunnel with knee at 90 flexion, positioning the "composite" (Beath pin within reamer) at 90 flexion and then Hyper flexing, pining and reaming. Back wall was preserved by selection of appropriate increment of aimer offset using Transportal Guide (TPG). For example, for a 9-mm-diameter reamer, a 7-mm-offset Transportal Guide was selected to ensure a 2.5- mm back wall (7mm offset – [9/2] = 2.5 mm back wall). The centrum of the planned femoral socket was marked before the knee was hyperflexed. This allows familiar 90° knee flexion position visualization of the true back wall of the notch, O'clock position. In the familiar 90° knee flexion position, the Transportal Guide was brought through the AM portal and seated at the 10-o'clock position for a right knee or 2-o'clock position for a left knee. A 2.4-mm drill-tipped guide pin, or Beath pin, was brought through the Transportal Guide and impacted into the lateral wall of the notch at the centrum of the femoral socket to a depth of 3-5 mm by use of a mallet. The pin was removed with a Kocher clamp, the position of the mark inspected, and precise placement of the mark confirmed from 1 or more portals. Next, the composite (reamer preloaded with Beath pin) was placed via the AM portal in the familiar 90° flexion position. With the knee remaining at the comfortable and familiar 90° flexion position, the reamer was used as a "Beath pin sleeve" and the Beath pin was slid through the reamer until the point of the Beath pin was seen to be accurately seated at the marked centrum. Size of the reamer depends on the size of interference screws to be used. Now, before reaming, the reamer was seated on bone and continued to serve as the Beathpinsleeve. Then knee was hyperflexed. Arthroscopic camera was positioned superior to the pin-reamer composite, looking down. Knee position was rigidly maintained to avoid bending the Beath pin. After the previously mentioned steps, the pin, acorn reamer, camera, and knee were in the proper position. A drill drives the Beath pin through the femur and out the anterolateral thigh. Next, because the reamer was already in position (composite), the drill was removed from the Beath pin and a power reamer was chucked to the acorn reamer without additional steps or fiddle-factor. Finally, the ACL femoral socket was reamed through the AM portal. The free ends of an ethibond suture were loaded on the Beath pin, which advanced out of the anterolateral thigh. The femoral graft-passing suture was left in the femoral socket for later retrieval and graft passage. Four anatomic landmarks were used to locate the tibial tunnel centre: the anterior horn of lateral meniscus, the medial tibial spine, the PCL, and the ACL stump. The site was located in the anteroposterior plane by extending a line in continuation with the inner edge of the anterior horn of the lateral meniscus. This point is located 6 to 7 mm anterior to the anterior border of the PCL. The mediolateral placement of the tunnel centre corresponded to the depression medial to the medial spine in the mediolateralcentre of the ACL stump. With the tunnel centre chosen, the patient's knee was flexed to 90 degrees, and the tip of the tibial drill guide was adjusted to create the desired tunnel length. The guidewire was drilled into place and its tip visualized as it entered the joint. The tibial tunnel was drilled with a cannulated drill, with diameter corresponding to diameter of interference screw to be used. The graft now ready for implantation was transferred from the tension board to the operating table. The loop of passage suture was taken out through the tibial tunnel and tied to ethibond suture whip stitched to end of graft. Graft was pulled into the tibial tunnel with the help of passage suture and viewed endoscopically to ensure that at least 20mm of graft is within the femoral socket. Graft was secured using femoral interference screw via the anteromedial port with knee in hyperflexion to ensure absolutely parallel screw placement. Femoral fixation was tested by applying distal traction to tibial end of graft suture. Knee was cycled five to ten times through a full range of motion with graft under tension. Tibial interference screw was placed with knee in full extension and graft under longitudinal traction to prevent proximal migration during screw advancement. Evaluation for notch impingement and tensioning was done. Standard post-operative rehabilitation was followed

RESULTS

The study included 60 patients of which only 52 patients completed 2 years follow up. The mean age in our series was 29.5 years with range from 19 – 50 years. Majority of the patients were males (84.6%) with M:F ratio 5.2:1. Majority of the patients had involvement of left side (69%) as compared to right side (31%). Most frequent mode of injury in our series was sports related injury (50%) followed by trauma due to fall (30%) and Road traffic accidents accounted for about (20%). Time since injury ranged from 6 weeks to 12 years with median of 12 months. All the patients had a detailed pre-operative examination and clinical assessment (Table 1).

Table 1. Patient demography and pre-operative evualtion

						Pre-operative					Tunnel position				Post-operative				
						Motion deficit (in degrees)		Muscle wasting (in cms)							Motion deficit		Muscle wasting		
S.No.	Age(yrs)	Sex	Side	Mode of injury	Time since injury	Flexion deficit	Extension deficit	Thigh	calf	Any concomitant procedure done	Saggital Quadrant Tibial	Coronal Quadrant Tibial	Coronal 0, Clock Femoral	Saggital Quadrant Femoral	Flexion deficit	Extension deficit	Thigh	Calf	Complications
1	40	F	L	FALL	3 YEARS	0	0	3	1	NONE	2	2	01:30	4	0	0	1	0	Hypoaesthesia over leg
2	42	M	L	SPORTS	5 YEARS	0	0	4	2	PMM	2	3	01:00	3	0	0	2	0	None
3	26	M	L	FALL	2 YEARS	0	10	7	2	PLM, PMM	2	2	01:00	4	0	5	3	1	Hypertrophic scar
4	25	M	R	RTA	2 YEARS	0	0	1	0	NONE	2	3	10:30	4	0	0	0	0	None
5	21	F	L	RTA	2.5 YEARS	0	0	4	1	PMM	2	2	01:30	4	0	0	2	1	Hypoaesthesia over leg
6	26	M	L	SPORTS	1YEAR	0	0	1.5	0	PMM	2	2	01:30	4	0	0	0	0	None
7	50	F	L	FALL	5 MONTHS	0	0	2	0	PMM	2	2	01:30	4	10	5	1	0	None
8	28	M	L	FALL	3 YEARS	0	0	2	2	NONE	2	2	01:30	4	0	0	1	1	Effusion
9	24	F	L	SPORTS	3 YEARS	0	0	3	2	NONE	2	2	01:30	4	0	0	2	2	Tender scar site
10	30	M	L	SPORTS	8 YEARS	0	10	2	0	PMM	2	3	01:30	4	0	5	1	0	None
11	20	M	R	FALL	9 MONTHS	0	0	2	2	NONE	2	2	10:00	4	0	0	1	1	None
12	24	M	R	FALL	4 MONTHS	0	0	2	1	NONE	2	2	10:30	4	0	0	2	1	Superficial wound Infection
13	30	M	L	SPORTS	2 YEARS	0	0	3	1	PLM	2	2	01:00	4	0	0	1	0	Breach of cortex
14	40	F	L	FALL	11 MONTHS	0	0	3	1	NONE	2	3	01:30	4	0	0	2	1	None
15	35	M	L	FALL	11 YEARS	0	0	3	2	NONE	2	2	01:00	4	0	0	2	1	None
16	27	M	R	FALL	3 YEARS	0	0	2	0	PMM	2	3	10:30	4	0	0	1	0	None
17	32	M	L	SPORTS	2 MONTHS	0	0	3	1	PMM	2	2	01:30	4	0	0	2	1	Hypoaesthesia over leg
18	40	M	R	RTA	6 WEEKS	0	0	1	0	PMM	2	2	10:30	4	0	0	0	0	None
19	34	M	R	SPORTS	6 WEEKS	0	0	4	1	NONE	2	2	10:30	4	0	10	3	1	None
20	32	M	L	RTA	2 YEARS	0	0	3	1	NONE	2	2	01:30	3	0	0	2	1	None
21	26	M	R	RTA	12 YEARS	0	0	3	2	PMM, PLM	2	2	10:30	4	0	0	1	1	None
22	19	M	L	RTA	4 MONTHS	0	0	2	0	NONE	2	2	01:30	4	0	0	1	0	Tender scar site
23	19	M	L	SPORTS	8 MONTHS	0	0	2	0	PMM	2	2	01:30	4	0	0	1	0	Hypoaesthesia over leg
24	40	M	R	RTA	6 MONTHS	0	0	1	0	PLM	2	2	10:30	4	0	0	0	0	None
25	25	F	L	FALL	6 MONTHS	0	10	4	1	PLM	3	3	01:30	4	10	5	3	1	Tender scar site
26	20	M	R	SPORTS	12 MONTHS	0	0	3	1	PMM	2	2	10:30	4	0	0	1	0	None
27	35	M	L	SPORTS	5 MONTHS	10	0	2	1	NONE	2	2	01:30	4	10	0	1	0	None
28	36	M	R	SPORTS	12 MONTHS	0	0	2	1	PMM	2	2	11:00	4	0	0	0	0	Hypoaesthesia over leg
29	24	M	L	SPORTS	8 MONTHS	0	0	3	1	PMM	2	2	01:30	4	10	10	2	1	None
30	26	M	L	SPORTS	6 MONTHS	0	0	2	0	NONE	2	2	01:30	4	10	0	1	0	None
31	28	M	L	FALL	3 YEARS	0	0	2	2	NONE	2	2	01:30	4	0	0	1	1	Effusion
32	32	M	L	SPORTS	2 MONTHS	0	0	3	1	PMM	2	2	01:30	4	0	0	2	1	Hypoaesthesia over leg
33	30	M	L	SPORTS	2 YEARS	0	0	3	1	PLM	2	2	01:00	4	0	0	1	0	None
34	36	M	L	SPORTS	6 WEEKS	0	0	4	1	NONE	2	2	01:30	4	0	10	3	1	Effusion
35	27	M	R	FALL	2 YEARS	0	10	7	2	PLM, PMM	2	2	10:30	4	0	5	3	1	Hypertrophic scar
36	20	M	L	SPORTS	8 MONTHS	0	0	2	0	PMM	2	2	01:30	4	0	0	1	0	Hypoaesthesia over leg
37	42	M	L	SPORTS	5 YEARS	0	0	4	2	PMM	2	3	01:00	3	0	0	2	0	None
38	26	M	L	SPORTS	1YEAR	0	0	1.5	0	PMM	2	2	01:30	4	0	0	0	0	None
39	20	M	R	FALL	9 MONTHS	0	0	2	2	NONE	2	2	10:00	4	0	0	1	1	Breach of cortex
40	25	M	L	RTA	2 YEARS	0	0	1	0	NONE	2	3	01:30	4	0	0	0	0	None
41	20	M	L	SPORTS	1 YEAR	0	0	3	1	PMM	2	2	01:30	4	0	0	1	0	None
42	35	M	L	FALL	2 YEARS	0	0	3	2	NONE	2	2	01:00	4	0	0	2	1	None
43	36	M	L	SPORTS	1 YEAR	0	0	2	1	PMM	2	2	01:00	4	0	0	0	0	Hypoaesthesia over leg
44	26	M	R	FALL	4 MONTHS	0	0	2	1	NONE	2	2	10:30	4	0	0	2	1	None
45	22	F	L	SPORTS	3 YEARS	0	0	3	2	NONE	2	2	01:30	4	0	0	2	2	None
46	26	M	R	RTA	4 YEARS	0	0	3	2	PLM	2	2	10:30	4	0	0	1	1	None
47	25	F	L	FALL	6 MONTHS	0	10	4	1	NONE	3	3	01:30	4	10	5	3	1	Tender scar site
48	40	M	L	SPORTS	5 MONTHS	10	0	2	1	PLM	2	2	01:30	4	10	0	1	0	None
49	26	M	L	SPORTS	8 MONTHS	0	0	2	0	NONE	2	2	01:30	4	0	0	1	0	None
50	38	M	R	RTA	6 MONTHS	0	0	1	0	PLM	2	2	10:30	4	0	0	0	0	Superficial wound Infection
51	32	M	L	SPORTS	8 YEARS	0	10	2	0	PMM	2	3	01:30	4	0	0	1	0	None
52	24	M	R	SPORTS	6 MONTHS	0	0	3	1	PMM	2	2	10:30	4	10	10	2	1	Hypoaesthesia over leg

Table 2. Patient evaluation using Lysjolm Score, Tegner Activity Level and Single Leg Hop Test

S.No.	Lysholm score				Tagner activity level				Single leg hop test				Lanchman test				Pivot shift test			
	Pre-op	6 Months	1 Year	2 Years	Pre-op	6 Months	1 Year	2 Years	Pre-op	6 Months	1 Year	2 Years	Pre-op	6 Months	1 Year	2 Years	Pre-op	6 Months	1 Year	2 Years
1	58	90	95	95	2	3	5	5	62	85	89	92	3	0	0	0	2	0	0	0
2	42	92	96	96	3	5	6	6	56	92	94	94	3	0	0	0	2	0	0	0
3	49	95	97	97	4	6	7	7	52	90	94	94	3	0	0	0	2	0	0	0
4	44	95	97	97	4	7	8	8	45	90	92	92	3	0	0	0	2	0	0	0
5	42	80	84	86	2	4	5	5	52	77	80	80	3	2	2	2	2	1	1	1
6	77	95	98	98	4	7	8	8	71	90	98	98	2	0	0	0	1	0	0	0
7	44	92	95	95	2	3	4	4	48	76	80	80	2	0	0	0	1	0	0	0
8	59	92	96	96	3	5	7	7	62	90	94	94	3	1	1	1	2	1	1	1
9	64	82	86	86	3	3	6	6	62	86	92	92	3	1	1	1	1	0	0	0
10	62	95	96	96	3	6	7	7	64	90	92	92	3	0	0	0	2	0	0	0
11	62	78	86	86	3	5	6	6	54	75	79	79	3	0	0	0	2	0	0	0
12	63	87	91	91	4	5	5	5	58	82	89	89	3	2	2	2	2	2	2	2
13	67	96	98	98	4	6	8	8	71	92	94	94	2	0	0	0	1	0	0	0
14	56	86	89	89	3	5	5	5	40	80	84	84	3	0	0	0	2	0	0	0
15	48	90	96	96	3	4	6	6	60	84	86	86	3	1	1	1	2	1	1	1
16	60	90	95	95	3	5	6	6	48	86	90	90	3	0	0	0	2	0	0	0
17	50	92	95	95	3	5	6	6	46	84	88	88	2	1	1	1	1	1	1	1
18	54	92	95	95	3	5	7	7	60	90	92	92	3	0	0	0	3	0	0	0
19	60	90	96	96	3	6	7	7	54	90	94	94	2	0	0	0	1	0	0	0
20	36	90	92	92	3	5	5	5	50	82	88	88	3	0	0	0	2	0	0	0
21	56	90	96	96	3	5	6	6	70	94	96	96	3	0	0	0	2	0	0	0
22	44	86	90	90	4	5	7	7	60	82	88	88	3	0	0	0	2	0	0	0
23	55	95	98	98	4	6	7	7	56	84	86	86	2	1	1	1	1	1	1	1
24	58	84	88	88	4	5	6	6	70	90	96	96	2	0	0	0	1	0	0	0
25	42	72	80	80	2	3	4	4	46	76	80	80	3	1	1	1	2	0	0	0
26	60	92	95	95	2	6	7	7	70	92	94	94	2	0	0	0	1	0	0	0
27	58	90	96	96	3	5	6	6	60	90	94	94	3	0	0	0	2	0	0	0
28	55	96	98	98	4	6	7	7	60	94	98	98	2	0	0	0	1	0	0	0
29	60	92	96	96	3	5	5	5	54	90	92	92	3	1	1	1	2	0	0	0
30	48	90	96	96	3	5	5	5	36	82	88	88	3	0	0	0	2	0	0	0
31	59	92	96	96	3	5	7	7	62	90	94	94	3	0	0	0	2	0	0	0
32	50	92	95	95	3	5	6	6	46	84	88	88	2	1	1	1	1	1	1	1
33	67	96	98	98	4	6	8	8	71	92	94	94	2	0	0	0	1	0	0	0
34	60	90	96	96	3	6	7	7	54	90	94	94	2	0	0	0	1	0	0	0
35	49	95	97	97	4	6	7	7	52	90	94	94	3	0	0	0	2	0	0	0
36	55	95	98	98	4	6	7	7	56	84	86	86	2	0	0	0	2	1	1	1
37	42	92	96	96	3	5	6	6	56	92	94	94	3	0	0	0	2	0	0	0
38	77	95	98	98	4	7	8	8	71	90	98	98	2	0	0	0	1	0	0	0
39	62	78	86	86	3	5	6	6	54	75	79	79	3	0	0	0	2	2	2	2
40	44	95	97	97	4	7	8	8	45	90	92	92	3	0	0	0	2	0	0	0
41	60	92	95	95	2	6	7	7	70	92	94	94	2	0	0	0	1	0	0	0
42	48	90	96	96	3	4	6	6	60	84	86	86	3	1	1	1	2	1	1	1
43	55	96	98	98	4	6	7	7	60	94	98	98	2	0	0	0	1	0	0	0
44	63	87	91	91	4	5	5	5	58	82	89	89	3	2	2	2	2	0	0	0
45	64	82	86	86	3	3	6	6	62	86	92	92	3	1	1	1	1	0	0	0
46	56	90	96	96	3	5	6	6	70	94	96	96	3	0	0	0	2	0	0	0
47	42	76	80	82	2	3	4	4	46	76	80	80	3	1	1	1	2	0	0	0
48	58	90	96	96	3	5	6	6	60	90	94	94	3	0	0	0	2	0	0	0
49	48	90	96	96	3	5	5	5	36	82	88	88	3	0	0	0	2	0	0	0
50	58	84	88	88	4	5	6	6	70	90	96	96	2	0	0	0	1	0	0	0
51	62	95	96	96	3	6	7	7	64	90	92	92	3	0	0	0	2	0	0	0
52	60	92	96	96	3	5	5	5	54	90	92	92	3	1	1	1	2	0	0	0

Single leg hop test, Tegner activity level and Lysholm scoring was done. Stability was checked using Lachman and Pivot shift tests. Any wasting of thigh and calf was documented. Notch index was determined. The Lysholm score ranged from 36 to 77 with a mean score of 55.23 points. Tegner activity level after injury ranged from 2 to 4 with a mean of 3.2. Measurements of single leg hop test ranged from 36 to 71 with a mean value of 57.2%. Mean notch index determined from MRI was 0.28 with range of 0.22 to 0.36. Initial assessment was done at six months followed by final assessment at 2yrs. The Lysholm functional score improved from a mean pre-operative value of 55.23 (range 36 – 77) to 89.88 at six months (76-96) and improved to 93.8(range 80 – 98) at final follow up. The Tegner activity level improved from a mean pre-operative value (post injury) of 3.13 (range 2 – 4) to mean postoperative value of 5.13 at six months to 6.3 (range 4 – 8) at final follow up. The Single leg hop test measurements improved from a mean preoperative value of 57.2% (range 40 – 71) to 86.76 at six months and 90.5 (range 79 – 98)at final follow up assessment (Table 2).

In sagittal plane, centre of the tibial tunnels were in quadrant 2 in 50 patients and in quadrant 3 in 2 patients. When compared in the coronal plane, the tibial tunnel centre was located in quadrant 2 in 42 patients and in quadrant 3 in 10 patients. Femoral tunnel centre was located in quadrant 4 in 49 patients and 3 patients had the tunnel in 3rd quadrant in the sagittal plane. In coronal plane femoral tunnels were at 01:30 O'clock or 10:30 O'clock in 43 patients and 9 patients had the tunnel at 01:00 O'clock or 11:00 O'clock position. Mean axis of screw was 370 from anatomical axis of femur. At final follow up, 38 (74%) patients had grade 0, 11 (21%) patients had grade 1 and 3 (5%) patients had grade 2 Lachman test grades. None of the patients had grade 3 Lachman tests at final follow up. Pivot shift test was grade 0 in 42 (82%) patients, grade 1 in 8 (15%) patients and grade 2 in 2 (3%) patient. None of the patients had grade 3 pivot shift value at final follow up. At final follow up of 6 months 39 (75%) patients had no motion deficit. Isolated flexion deficit of 10 degrees was noticed in 3 patients and 2 patients had isolated extension deficit of 10 degrees. 3 patients had combined flexion deficit of 10 degrees and extension deficit of 5 degrees. 2 patients had combined flexion deficit of 10 degrees and extension deficit of 10 degrees at final follow up. As per IKDC evaluation criteria 42 patients had grade A, 8 patients had grade B and 2 patients had grade C passive motion deficit. Final results were excellent in 38 (73%) patients, good in 12 (23%) patients and fair in 2 (3.8%) patients. None of the patients had poor result at final follow up.

Complications

Intraoperative complications include breach of posterior femoral cortex in two patients during drilling of the femoral tunnel, graft cut out in one patient during fixation of graft on femoral side, difficulty in graft harvesting in two patients and damage to medial femoral condylar cartilage in two patients during drilling of femoral tunnel. In postoperative period two patients developed knee effusion and two patients developed superficial wound infection at the graft harvest site. Four patients developed tenderness at the graft harvest site. Nine patients (30%) complained of numbness and paraesthesia over the anterolateral aspect of leg. Hypoesthesia was found localized to distribution of infra patellar branch of saphenous nerve. Tibial screw removal was done in one patient because of prominent screw and pain over the screw site.

DISCUSSION

The arthroscopic single and double bundle reconstruction with hamstring graft using suspensory fixation has given excellent results so far. With most of these techniques, however, an indirect extra-anatomic fixation far from the articular surface was performed. Because extra-anatomic fixation techniques, rather than aperture fixation techniques, are associated with graft tunnel motion, windshield wiper action, and suture stretch-out, concerns may arise regarding delayed biological incorporation, tunnel enlargement, and secondary rotational and anterior instability (Brucker *et al*., 2006). Early failure is typically associated with compromised strength at one of the fixation points because graft incorporation is incomplete (Jeffrey Wilde *et al*., 2014). To overcome these theoretical disadvantages aperture fixation has been advised. Peter Fauno & Kaalund (Fauno and Kaalund, 2005) in their study observed significant reduction in tunnel widening in both femur and tibia using fixation points close to the joint. Mark D. Porter and Bruce Shadbolt (2016) found significant reduction in both anterior translation and internal rotation during pivot shift test. In his study before ACL reconstruction, the mean (±SD) AT was 14.2 ± 7.3 mm and mean IR was 17.2° ± 5.5°. After reconstruction using femoral cortical suspension, these figures were significantly reduced to 6.2 ± 3.5 mm and 12.5° ± 3.20°, respectively (P < .001). The addition of the aperture fixation was associated with a further significant reduction to 4.6 ± 3.2 mm and 10.4° ± 2.7°, respectively (P < .001).

Hegde *et al*. (2014) in his prospective study of comparison of functional outcomes between bioabsorbable and metallic interference screws in arthroscopic anterior cruciate ligament reconstuctions, which were evaluated by using Tegner activity scale and Lysholm knee scoring scale for a period of 1 year, found no statistically significant difference between the two. SimilarlyShen *et al*. (2010) in their meta-analysis found no significant difference in measurement results of knee joint stability or knee joint function outcome between bioabsorbable and metallic interference screws. Knee joint effusion is more common after ACL reconstruction with bioabsorbable interference screw fixation than with metallic interference screw fixation. In our prospective study males outnumbered females with the predominant mode of injury being sports followed by fall on ground and RTA which is consistent with the literature. Left side is predominantly involved. The LysholmFunctional Score improved from 55.23 to 93.8 at the final follow up. The Tegner activity level improved from a mean pre-operative value of 3.13 to 5.27 at final follow up while Single leg hop test improved from 55.7% preoperatively to 90.5% at the final assessment. No cases of fixation failure or revision were observed over a period of two years. This new fixation technique gives excellent results with the theoretical advantage of early graft incorporation and better arthrometric stability facilitating early rehabilitation and return to pre injury activity level. However, longer follow up is needed to authenticate these advantages.

Conclusion

ACL reconstruction using quadrupled hamstring auto graft and interference screw fixation is safe and highly successful with very few complications. Accelerated rehabilitation is possible in view of strong fixation of graft using interference screws.

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