



International Journal of Orthopaedics Sciences

E-ISSN: 2395-1958
P-ISSN: 2706-6630
IJOS 2019; 5(4): 358-363
© 2019 IJOS
www.orthopaper.com
Received: 02-08-2019
Accepted: 04-09-2019

Dr. Shekhar Tank
Assistant Professor,
Orthopaedics, Maharaja Agrasen
Medical College, Agroha, Hisar,
Haryana, India

Dr. Puneet Kamra
Senior Resident,
Orthopaedics, Maharaja Agrasen
Medical College, Agroha, Hisar,
Haryana, India

Dr. Nishant Verma
Assistant Professor,
Orthopaedics, Maharaja Agrasen
Medical College, Agroha, Hisar,
Haryana, India

Dr. Vinod Kumar
Director Professor and Head of
Department, Orthopaedics,
Maulana Azad Medical College
and Associated Lok Nayak
Hospital, New Delhi, India

Dr. Surender Singh
Senior Resident,
Orthopaedics, Maharaja Agrasen
Medical College, Agroha, Hisar,
Haryana, India

Corresponding Author:
Dr. Puneet Kamra
Senior Resident,
Orthopaedics, Maharaja Agrasen
Medical College, Agroha (Hisar),
Haryana, India

Comparison of functional outcomes of double-bundle anterior cruciate ligament (ACL) reconstruction with and without use of dedicated zig for femoral and tibial tunnel preparation

**Dr. Shekhar Tank, Dr. Puneet Kamra, Dr. Nishant Verma, Dr. Vinod
Kumar and Dr. Surender Singh**

DOI: <https://doi.org/10.22271/ortho.2019.v5.i4f.1697>

Abstract

Aim: To compare the functional outcomes of double-bundle anterior cruciate ligament (ACL) reconstruction with and without use of dedicated zig for femoral and tibial tunnel preparation.

Materials and Methods: Forty patients with ACL deficient knees fulfilling the inclusion criteria were selected and after careful alternate randomization, twenty each underwent ACL reconstruction surgery with and without using dedicated zig for tibial and femoral tunnel preparation respectively. Post operatively patients were followed up regularly with clinical evaluation based on IKDC (International Knee Documentation Committee) and modified Lysholm's score and knee stability tests viz. anterior drawer, lachman's and pivot shift tests. Final evaluation was done at 6 months and results were compared between the two techniques.

Results: Forty patients ranging from 18 to 42 years, with mean age of 26.4 years in zig group and 24.6 years in freehand group with complete ACL tear included in study. All cases in both groups were males and sports injury being the most common mode of injury in both groups. Post operatively none of patient shows frank laxity in both groups. Average IKDC and modified Lysholm's score at 6 month were 74.6/92.2 and 73.67/93.9 respectively. No major complication was noted and functional results were comparable between two groups.

Conclusions: Functional results with both techniques are good and comparable and choice depends on surgeon's skills and preference.

Keywords: Anterior cruciate ligament, lysholm score, knee laxity

Introduction

With increasing sports activities, injuries to the knee ligaments are on increase. Anterior cruciate ligament (ACL) is the most commonly injured ligament of knee ^[1] and most common serious injury of the knee ^[2]. ACL injury is functionally disabling and predisposes the knee to further injury while also promoting early onset of degenerative changes of the knee, primarily attributable to the loss of the essential function of ACL, which is to prevent the anterior displacement of the tibia relative to the femur and restrain internal rotation and valgus angulation. Anatomical, biomechanical and arthroscopic studies have shown that ACL consists of anteromedial (AM) bundle which primarily provides anterior translational stability and posterolateral (PL) bundle which provides rotatory stability and presence of both are indispensable for knee stability.

Treatment of ACL ligament injuries still remains a controversial subject. Conventionally, these injuries have been treated by non-operative methods. With increased demands, particularly in young athletic individuals, the treatment of ACL injury has shifted more towards operative side. ACL reconstruction is an established and widely practiced surgery with good outcomes and low morbidity ^[3]. Currently, the two common arthroscopic techniques being used for ACL reconstruction are the single bundle and the double bundle technique. Whereas a Single Bundle ACL reconstruction focuses on recreating the whole ACL as a single bundle, ignoring its two functional bundle anatomy; a Double-bundle ACL reconstruction technique involves

reconstruction of each of the functional bundles i.e. AM and PL and thus attempting to restore the natural anatomy of ACL. Recent studies have contributed substantially to our understanding of anterior cruciate ligament anatomy and have revealed that common techniques for ACL reconstruction may fail to replicate native ligament origin or insertions. This has led to a growing interest in anatomic single-bundle and double-bundle ACL reconstruction, with the goal of better replicating the anatomy of the native ACL and resulting superior clinical outcomes.

Considering the variability in placement of anatomic femoral and tibial tunnels in ACL reconstruction and their results by different technique i.e. use of dedicated zig or anatomic footprint method by different surgeons and based on the inferences of their reviews, a working model was adopted for the present study. Wherein, we have made use of either a dedicated zig or the freehand technique (i.e. anatomic footprint visualization arthroscopically) for anteromedial and posterolateral femoral and tibial tunnels placement in double bundle ACL reconstruction.

The purpose of this study is to compare the functional outcomes of double-bundle anterior cruciate ligament (ACL) reconstruction with and without use of dedicated zig for femoral and tibial tunnel preparation.

Materials and Methods

The proposed study was conducted in the department of Orthopaedics, Maulana Azad Medical College and associated hospitals and comprised 40 patients with ACL deficient knees after obtaining informed consent from the study subjects. Out of forty patients, after careful alternate randomization (approved by Departmental and Institutional committee) twenty each underwent anterior cruciate ligament reconstruction surgery with and without using dedicated zig for tibial and femoral tunnel preparation respectively.

Inclusion Criteria

1. Clinico-Radiologically diagnosed symptomatic cases of ACL tear with unstable knee.
2. Age between 18 and 50 yrs.

Exclusion Criteria

1. Age less than 18 yrs and more than 50 yrs.
2. Patients having pre-existing degenerative changes in the knee.
3. Poorly motivated patients.
4. Patients with other ligament injuries requiring operative repair or reconstruction.
5. Patients with history of previous knee surgeries.

After appropriate clinico-radiological assessment and pre-operative investigations, patients were posted for surgery. Under general or spinal anesthesia, patient was placed supine on the operating table. A well padded tourniquet was placed high up on the thigh.

Hamstring Graft Harvesting and Preparation

The hamstring tendons were harvested with knee placed in 80-90 degrees of flexion through 3cm to 4cm long oblique incision made over 3cm to 4cm distal to the joint line and 1cm to 2cm medial to the tibial tuberosity on anteromedial tibia. Semitendinosus and Gracilis tendons were taken for all the cases and folded to make double stranded anteromedial and posterolateral bundles respectively following standard graft preparation steps. Grafts were secured by no.2 ethibond non-

absorbable sutures, sutured at free end and looped at the other end. This construct was passed through sizing tubes to determine graft diameter. After the size of the Endobutton to be used was known, the graft was then looped through the closed loop of the Endobutton and marked after determining the graft insertion length. The finally prepared graft was wrapped in a wet sponge.

Portal preparation

Standard anterolateral and anteromedial portals were created. Diagnostic arthroscopy was performed and in cases where associated injuries for example meniscal tears were diagnosed, meniscectomy done. Intercondylar notch was evaluated and cleaned. ACL stump was debrided partially, leaving a substantial portion to guide tunnels placement.

Tunnel preparation

With Zig

Out of forty, in twenty of our cases, we used dedicated zig (Smith and Nephew Double Bundle ACL instrumentation) along with standard instrument for ACL reconstruction. In double bundle reconstruction two separate tunnels were prepared in femur and tibia for anteromedial and posterolateral bundles after carefully locating the landmarks for each bundle. In all our cases we prepared femoral tunnel first.

Femoral Tunnel

Anteromedial Tunnel: AM femoral tunnel was drilled through the AM portal using either a 5mm or 6 mm Smith & Nephew offset Endofemoral Aimer. The knee was bent to 90° to place the guide 5-6 mm anterior to the posterior edge of the intercondylar notch. Once the guide was in place, the knee was slowly flexed to between 110 and 120 degree to ensure the proper orientation of the AM tunnel. A 2.4mm drill tip guide wire was advanced through the offset Endofemoral guide and drilled through the femur until the guide wire "broke" through the lateral femoral cortex. A cannulated 4.5mm Endobutton drill bit was advanced over the passing pin and the lateral femoral cortex was breached. The 2.4mm guide wire was then removed. The Endobutton depth probe was used to measure the total length of the AM femoral tunnel and to calculate the appropriate Endobutton CL length. The 2.4mm guide wire was reinserted through AM tunnel. An endoscopic cannulated drill bit was selected that matched the graft diameter and was used to produce the AM femoral socket. Depth was regulated according to the desired insertion length and should be 5 mm greater than the desired graft insertion to allow for the Endobutton to flip.

Posterolateral Tunnel: Keeping the knee flexed to 100-110°, anatomic ACL R-PL Femoral Aimer was inserted with an appropriately-sized post into the AM tunnel. It was ensured that the shoulder of the AM post was in contact with the lateral wall of the intercondylar notch. The aimer was rotated until the laser mark on the aimer is aligned with the center of the RF probe/awl mark previously made for the PL bundle insertion site. The PL femoral guide wire was set at a point 5-8 mm anterior to the edge of joint cartilage with knee in 90 degree flexion. Proper placement of the aimer is critical to achieving an adequate bone bridge. Once the aimer was properly placed, a 4.5mm non cannulated drill bit was inserted and drilled through the lateral femoral cortex. The PL femoral aimer insert was removed and the length of the PL tunnel was measured with the Endobutton depth probe. A 2.4

mm drill tip guide wire was inserted through the PL tunnel. An endoscopic drill bit was selected that matched the graft diameter and used to produce the PL femoral socket. Depth was regulated according to the desired insertion length and should be 5 mm greater than the desired graft insertion.

Tibial tunnel preparation

Tunnel for AM bundle: The anatomic insertion of the AM and PL bundles of the ACL on the tibia were identified and were marked with either an RF probe or an awl. Accuflex™ ACL Tip Aimer (REF 7205519) was set at 50 degrees for the placement of the anteromedial guide wire. Attention should be paid to the placement of the anteromedial guide wire, which should exit in the center of the AM bundle and not in the center of the ACL. The AM tibial tunnel in the anatomic reconstruction technique was more anteriorly located than that in the traditional single bundle reconstruction. A 2.4 mm drill tip guide wire was advanced through the tibia. Once acceptable placement of the tibial guide wire was obtained, the appropriately-sized cannulated drill bit was advanced into the joint space.

Tunnel for PL bundle: The appropriately-sized post was placed on the Smith & Nephew Anatomic ACL R-PL Tibial Aimer. Once the post was secured, it was inserted into the AM tibial tunnel until the distal end was flushed with the tibial surface. It should be ensured that the post is not protruding into the joint nor recessed in the tunnel. The tibial aimer has a slot at the tip of the AM tunnel post. This slot should be oriented to align with the anticipated center of the PL bundle. Once proper alignment was achieved, the bullet was advanced against the tibia. The PL tunnel has a more medial and distal entry point on the tibial cortex than a standard tibial tunnel. A 2.4mm drill tip guide wire was advanced through the tibia. Once acceptable placement of the PL tibial guide wire was obtained, the appropriately sized cannulated drill bit in to the joint space. An osseous bridge of approximately 2-3 mm should remain between two tunnels inside the joint. The diameter of the tunnels for anteromedial bundle is usually 6-8 mm and that of the posterolateral bundle 5-7 mm.

Without Zig

Out of forty, in twenty of our cases we used free hand technique, used only standard instrument and arthroscopic visualization of anatomic remnants for femoral and tibial tunnel preparation.

Femoral Tunnel

Anteromedial Tunnel: AM femoral tunnel was drilled through the AM portal. The knee was bent to 90° to place the tip of 2.4 mm guide wire over anatomical footprint of AM bundle. Once the guide was in place, the knee was slowly flexed to between 110 and 120 degree to ensure the proper orientation of the AM tunnel. A 2.4mm drill tip guide wire was advanced and drilled until the guide wire “broke” through the lateral femoral cortex. The 2.4mm guide wire was felt just under the skin after it exits the cortex to determine its position. A cannulated 4.5mm Endobutton drill bit was advanced over the passing pin upto lateral femoral cortex. The 2.4mm guide wire was then removed and depth probe was used to measure the total length of the AM femoral tunnel and to calculate the appropriate Endobutton CL length. The 2.4mm guide wire was inserted through the AM tunnel. An appropriate sized endoscopic cannulated drill bit was used to

produce the AM femoral socket. Depth was regulated according to the desired insertion length and should be 5mm greater than the desired graft insertion to allow for the Endobutton to flip.

Posterolateral Tunnel: Keeping the knee flexed to 100-110°. A 2.4 mm femoral guide wire tip was set at anatomical footprint and remnant of fibers of PL bundle, visible arthroscopically or a point where the imaginary line drawn through the contact point between femoral condyle and the tibial plateau with knee in 90 degree flexion met another imaginary line drawn through the long axis of ACL attachment or otherwise at a point 5-8 mm anterior to the edge of joint cartilage with knee in 90 degree flexion. A 2.4mm drill tip guide wire was advanced and drilled through the femur until the guide wire “broke” through the lateral femoral cortex. A 4.5mm cannulated drill bit was inserted and drilled through the lateral femoral cortex. The 2.4mm guide wire was then removed and the length of the PL tunnel was measured with the Endobutton depth probe. A 2.4 mm drill tip guide wire was inserted through the PL tunnel. An endoscopic drill bit was selected that matched the graft diameter and used to produce the PL femoral socket. Depth was regulated according to the desired insertion length and should be 5 mm greater than the desired graft insertion length.

Tibial tunnel preparation

Tunnel for AM bundle: The anatomic insertion of the AM and PL bundles of the ACL on the tibia were identified. These insertion sites were marked with either an RF probe or an awl. Accuflex™ ACL Tip Aimer (REF 7205519) was set at 50 degrees for the placement of the anteromedial guide wire. Attention should be paid to the placement of the anteromedial guide wire, which should exit in the center of the AM bundle and not in the center of the ACL. The AM tibial tunnel in the anatomic reconstruction technique was more anteriorly located than that in the traditional single bundle reconstruction. A 2.4 mm drill tip guide wire was advanced through the tibia. Once acceptable placement of the tibial guide wire was obtained, the appropriately-sized cannulated drill bit was advanced into the joint space.

Tunnel for PL bundle: Only Accuflex™ ACL Tip Aimer (REF 7205519) was set at 50 degrees for the placement of the posterolateral guide wire (Without placing the post on the Smith & Nephew Anatomic ACL R- PL Tibial Aimer for PL tunnel). Attention should be paid to the placement of the posterolateral guide wire, which should exit in the center of the PL bundle and not in the center of the ACL. The PL tunnel has a more medial and distal entry point on the tibial cortex than a standard tibial tunnel. A 2.4mm drill tip guide wire was advanced through the tibia. Once acceptable placement of the PL tibial guide wire was obtained, the appropriately sized cannulated drill bit in to the joint space.

Final Graft Passage and Fixation

In our study, fixation method on the femoral side was titanium Endobutton with continuous loop mersilene tape and on the tibial side bioabsorbable interference screws were used. After femoral fixation, tibia was pushed backward, tension was applied and the AM bundle fixed between 45° and 60° of flexion, followed by PL bundle fixation in full extension. Full range of motion was achieved after fixation of the AM and PL bundles and there was no impingement in notch. So, no notchplasty was performed. The wound was

closed in layers, sterile dressings and crepe bandage applied with knee brace in extension.

Rehabilitation

The mid path rehabilitation protocol of the ACL was adopted. But instead of returning to full function after 9th month, aggressive rehabilitation was encouraged and returns to full activities after 6 months to increase patient's compliance.

Follow up and evaluation:

Clinical evaluation based on IKDC (International Knee Documentation Committee) [4] and modified Lysholm's score [5] was done at 2 weeks, 4 weeks, 6 weeks, 2 months, 4 months and finally at 6 months. Clinical tests of knee stability viz. anterior drawer, lachman's and pivot shift tests done at 2 months, 4 months and 6 months. Final evaluation was done at 6 months and results were compared between the two techniques.

Statistical Analysis

Data analysis done with SPSS version 20 software. Qualitative data was expressed in percentages. Quantitative data expressed in means, median, and standard deviation. For difference with means in different groups, t-test was used for independent groups for normally distributed data and Mann-Whitney test for data not normally distributed. Wilcoxon test was used to observe difference of means for paired value where data was not normally distributed. Repeated ANOVA was applied to observe the difference among means at

different time periods. Two way ANOVA was used to observe the difference with mean at different time periods and also for different groups. $P < 0.05$ taken as significant.

Results and Observations

Forty patients ranging from 18 to 42 years, with mean age of 26.4 years in zig group and 24.6 years in freehand group with complete ACL tear included in study. All cases in both groups were males. Sports injury being the most common mode of injury in both groups (50% in zig group and 70% in freehand group patients) followed by road traffic accident.

Table 1: Age distribution of cases of ACL deficient patients

Age group (years)	No. of Patients	
	Zig group (n=20)	Free Hand group (n=20)
10-20	6 (30%)	8 (40%)
21-30	8 (40%)	8 (40%)
31-40	4 (20%)	2 (10%)
41-50	- 2 (10%)	2 (10%)
Mean age \pm SD	26.4 \pm 8.54	24.6 \pm 7.919

p = 1 (Non-Significant)

Table 2: Patient distribution based on mode of injury

Mode of injury	Zig group (n=20)	Free Hand group (n=20)
Sports activities	10 (50%)	14 (70%)
RTA	4 (20%)	4 (20%)
Fall on ground	6 (30%)	2 (10%)

Table 3: Lachman's test evaluation at different time intervals

Lachman's test	Pre-op		2 nd month		4 th month & 6 th month	
	Zig group	Free Hand group	ZIG	Free Hand group	ZIG	Free Hand group
Negative	0	0	16(80%)	16(80%)	14(70%)	16(80%)
Grade-1	0	0	4(20%)	4(20%)	6(30%)	4(20%)
Grade-2	0	0	0	0	0	0
Grade-3	20(100%)	20(100%)	0	0	0	0

Table 4: Anterior Drawer's Test evaluation at different time intervals

Anterior Drawer's Test	Pre-op		2 month		4 th & 6 th month	
	Zig	Free Hand group	Zig	Free Hand group	Zig	Free Hand group
Negative	0	0	16(80%)	16(80%)	14(70%)	16(80%)
Grade-1	0	0	4(20%)	4(20%)	6(30%)	4(20%)
Grade-2	0	0	0	0	0	0
Grade-3	20(100%)	20(100%)	0	0	0	0

Table 5: Pivot shift test evaluation at different time intervals

Pivot shift test	Pre-op		2 nd month		4 th & 6 th Month	
	ZIG	Free Hand group	ZIG	Free Hand group	ZIG	Free Hand group
Neg.	0	0	20(100%)	20(100%)	18(90%)	18(90%)
Grade 1	0	0	0	0	2(10%)	2(10%)
Grade 2	0	0	0	0	0	0
Grade 3	20(100%)	20(100%)	0	0	0	0

Table 6: IKDC scores evaluation at different time interval

Mean score %	Pre-op		2weeks		4weeks		6weeks		2months		4months		6months	
	ZIG	F.H.	ZIG	F.H.	ZIG	F.H.	ZIG	F.H.	ZIG	F.H.	ZIG	F.H.	ZIG	F.H.
IKDC	37.0	35.45	20.3	18.94	26.15	27.41	29.43	31.03	58.19	57.81	68.95	68.76	74.60	73.67
\pm SD	5.78	5.43	4.44	3.08	4.42	2.89	5.46	4.47	5.41	5.87	3.76	4.43	2.61	2.79

p= 0.866 (NS)

Table 7: Modified Lysholm's scores evaluation at different time interval

Mean score	Pre-op		2wks		4wks		6wks		2months		4months		6months	
	ZIG	F.H.	ZIG	F.H.	ZIG	F.H.	ZIG	F.H.	ZIG	F.H.	ZIG	F.H.	ZIG	F.H.
LYSCHOLM'S	59.7	60.4	50.1	53.1	56.9	58.2	60.8	59.4	82.7	80.4	87.0	87.6	92.2	93.9
± SD	6.53	3.73	4.63	3.31	5.66	5.26	3.45	4.6	4.73	2.63	4.10	3.53	6.16	3.95

P=0.499NS

Discussion

In our study of comparison of double bundle anterior cruciate ligament reconstruction using multistranded hamstring tendon with and without using dedicated zig for femoral and tibial tunnels preparation, we studied 40 patients with unilateral complete ACL tear that underwent ACL reconstruction in our institution.

It is well documented in literature that females participating in sports are more prone for ACL tears because of anatomic, environmental, hormonal and biomechanical factors. In our study all the patients in both the groups were males. This may be due to low rate of participation of females in sports activities in our country. In the zig group the average age of patients was 26.4 years and in the freehand group it was 24.6 years. Majority of patient were below 30 years of age, as in table 1. The difference in the mean age of the subjects in both groups was statistically not significant ($p=1$). According to the literature, age as an independent variable is not a factor influencing the outcome of ACL reconstruction but early osteoarthritic changes related to an older age are important. In our study, the most common cause of ACL injury was sports related activities, overall which constituted 60%, comparable to study conducted by Chaudhary *et al.* [6] in which sports injuries accounted 66.7%. This is in contrast to western literature, where it was described that 90% of patients sustained their injuries from sports related activities. This may be due to low level of sports activities in our country.

Lachman's test is a simple test which we can perform from 4th post-operative week. As this can be applied to a subject who hasn't attained full range of motion. Pre operatively all the ACL deficient patients in both groups had grade 3 Lachman's test positivity with a soft end point. When analyzed post operatively, none of our patient shows frank laxity (grade 2/ grade 3 positive Lachman's test), however, at 2 month onwards 80% each in both group showed negative Lachman's test. At 4th and 6th months 70% in zig group and 80% in freehand group showed negative Lachman's test. On statistical analysis the difference between these two groups showed no statistical significance ($p=1.00$). In the freehand group, the 4 patients showed grade 1 Lachman's test positivity at 6 months with an average IKDC score of 72.04 and an average Lysholm's score of 91 which is comparable to the total average score. In zig group 6 patients showed grade 1 Lachman's test positivity at 6 months and they had an average IKDC score of 72.78 and average Lysholm's score of 90.67 which is also comparable to the total average. According to literature grade 1 Lachman's test positivity can be found in normal population with an incidence of 9%. Hence despite a positive Lachman's test all the subjects had a good functional outcome. On comparison, our results are similar to previous literature by Asagumo *et al.* [7] and Muneta *et al.* [8], which shows negative Lachman's test in 90% and 95% of the patient respectively.

None of our patient shows grade 2/ grade 3 positive anterior drawer test, however, at 2 months anterior drawer's test was negative in 80% of patients in both zig and freehand group. At 6 months, 80% of patients in freehand and 70% of patient in

zig group showed negative anterior drawer's test. On statistical analysis the difference between these two groups showed no statistical significance ($p=1.00$). In the zig group, 6 ACL reconstructed knees showed grade 1 anterior drawer's test positivity at 6 months had an average IKDC score of 72.78 and average Lysholm's score of 90.67 which is comparable to the total average score. In freehand group 4 ACL reconstructed knees showed grade 1 Anterior drawer's test positivity at 6 months had an IKDC score of 72.04 and average Lysholm's score of 91 which is comparable to the total average. Hence despite a positive grade 1 anterior drawer's test these subjects had a good functional outcome. On comparison, our results are similar to study by Muneta *et al.* [8] which show negative anterior drawer in 87% of patient. Pivot shift test was another variable that we analyzed in our subjects. None of our ACL reconstructed knee show grade 2/grade 3 positive pivot shift test. However, 2 patients (10%) ACL reconstructed knee showed grade 1 positive pivot shift test at 4 months in both zig and freehand group. At 6 months also, pivot shift test findings remained same i.e. 90% ACL reconstructed knee in both zig and freehand group showed negative pivot shift test. On statistical analysis, the difference in pivot shift test results among the both groups were statistically not significant ($p=1.00$). The average IKDC and modified Lysholm's scores of two patients with positive pivot shift in zig group were 72.6 and 88.0 respectively. In freehand group the average IKDC and modified Lysholm's scores of two patients with positive pivot shift were 71.42 and 90.0 respectively. As we can see, these functional scores in subjects with positive pivot shift test in both groups are comparable to the mean score. This shows a good functional outcome despite positive pivot shift test. On comparison, our results are similar to previous literature by Zaffagnini *et al.* [9], Aglietti *et al.* [10], Asagumo *et al.* [7] and Muneta *et al.* [8] on double bundle ACL reconstruction.

We have used two types of scoring system for our evaluation viz. Lysholm's score and IKDC subjective knee evaluation score. There is inherent difference in these scoring systems. The Lysholm's score being more of an absolute scoring system whiles the IKDC is a percentile scoring. The mean pre-operative Lysholm's score among zig group was 59.7/100 and among freehand group it was 60.4/100. At 2 weeks the Lysholm's score in both groups declined significantly to 50.1/100 and 53.1/100 respectively for zig and freehand group. This was because, in Lysholm's score maximum score is given to locking, instability and pain. Locking and instability disappeared immediately after surgery but pain and other factors remained causing a decrease in the score. In both zig and freehand groups the modified Lysholm's score started rising above the pre operative score from 6th week onwards. On comparison of the modified Lysholm's scores between zig and freehand groups, we found no statistically significant difference at pre operatively, 2 weeks, 4 weeks, 6 weeks, 2 months, 4 months and at 6 months (0.499 NS). On comparison, our results are similar to previous study by Muneta *et al.* [8] and Asagumo *et al.* [7] on double bundle ACL reconstruction as in table 8.

Table 8: Comparison of Modified Lysholm's score

Present study	ZIG group	92.2±6.16
	Free Hand group	93.9±3.96
Asgumo <i>et al.</i> [7]		96.8±5.1
Muneta <i>et al.</i> [8]		94.5

The pre-op IKDC scores among zig and freehand groups were 37.0% and 35.45% respectively. At 2 weeks the IKDC scores of patients of zig and freehand groups were 20.30% and 18.94% respectively. In IKDC score maximum emphasis is given to activity level and pain. Because of the low tolerance of patients in early post operative period to these factors, there was a significant decrease in the score which rises above the pre-operative scores from 2nd post-operative month onwards in both groups. There was no statistically significant difference ($p=0.866$) between zig and freehand groups in IKDC score at different time intervals and our results are similar to previous literature by Zaffagnini *et al.* [9], Aglietti *et al.* [10] and Xu *et al.* [11] on double bundle ACL reconstruction as in table 9.

Table 9: Comparison of IKDC score

Present study	Zig group	74.6
	Freehand group	73.67
Zaffagnini <i>et al.</i> [9]		88±9
Aglietti <i>et al.</i> [10]		78±15
Xu <i>et al.</i> [11]		87.5

The major strength of our study is 100% follow up rate, procedure execution and follow up by same senior faculty member. However, strength of our results was limited by small sample size and shorter follow up period.

Conclusion

Our results of double bundle anterior cruciate ligament reconstruction using multi-stranded hamstring tendon grafts were excellent in terms of post-operative knee stability and patient satisfaction irrespective of the technique viz. the Zig and Freehand techniques. There was no significant difference between the functional result with two techniques in terms of knee laxity, modified Lysholm's score and IKDC scoring. No major complication is noted after surgery. Hence functional results with both techniques are comparable and choice depends on surgeon's skills and preference.

References

- Albright J, Carpenter J, Graf B, Richmond J. Knee and leg: soft tissue trauma. Orthopaedic knowledge update. 1999; 6:533-59.
- Sajovic M. Simultaneous bilateral Anterior Cruciate Ligament reconstruction with use of Hamstring tendon autograft: a case report. Journal of Surgery. 2013; 1(1):1-5.
- Ajuied A, Smith C, Wong F, Hoskinson S, Back D, Davies A. A Survey of Rehabilitation Regimens Following Isolated ACL Reconstruction. JMED Research, 2014, 1-9.
- Lysholm J, Gillquist J. Evaluation of knee ligament surgery results with special emphasis on use of a scoring scale. J Sports Med. 1982; 10:150-4.
- Irrgang JJ, Ho H, Harner CD, Fu FH. Use of the International Knee Documentation Committee guidelines to assess outcome anatomic femoral tunnel placement for two-bundle anterior cruciate ligament reconstruction. Arthroscopy. 2006; 22:356-61.

- Chaudhary D, Monga P, Joshi D, Easwaran R, Bhatia N, Singh AK. Arthroscopic reconstruction of the Anterior Cruciate Ligament reconstruction using bone-patellar tendon bone autograft: Experience of first 100 cases. Journal of Orthopaedic Surgery. 2005; 13(2):147-52.
- Asagumo H, Kimura M, Kobayashi Y, Taki M. Anatomic reconstruction of the ACL using double bundle hamstring tendons: surgical technique, clinical outcomes, and complication. Arthroscopy. 2007; 23:602-9.
- Muneta T, Koga H, Mochizuki T, Ju YJ, Hara K, Nimura A *et al.* A prospective randomized study of 4-strand Semitendinosus tendon anterior cruciate ligament reconstruction comparing single-bundle and double-bundle techniques. Arthroscopy. 2007; 23:618-28.
- Zaffagnini S, Bruni D, Marcheggiani Muccioli GM, Bonanzinga T, Lopomo N, Bignozzi S *et al.* Single-bundle patellar tendon versus non-anatomical double-bundle hamstrings ACL reconstruction: a prospective randomized study at 8-year minimum follow-up. Knee Surg Sports Traumatol Arthrosc. 2011; 19(3):390-7.
- Aglietti P, Giron F, Losco M, Cuomo P, Ciardullo A, Mondanelli N. Comparison between single- and double-bundle anterior cruciate ligament reconstruction: a prospective, randomized, single-blinded clinical trial. J Sports Med. 2010; 38:25-34.
- Yan Xu, Yingfang Ao, Jianquan Wang, Jiakuo Yu. Relation of tunnel enlargement and tunnel placement after single bundle ACL reconstruction. Arthroscopy. 2011; 27:23-32.