Effect of multiple instrumentation changing in transportal and transtibial techniques for anterior cruciate ligament reconstruction regarding bacterial contamination: a randomized controlled study

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Background
In transtibial technique (TT) for anterior cruciate ligament reconstruction (ACL-R) few instruments pass through the anteromedial portal track (probe, basket, diathermy), but in transportal (Anteromedial portal [AMP]) technique a lot of instruments pass through the anteromedial portal track (probe, basket, diathermy, wire, drill, and screw).

Purpose
To detect the instrumentation changing effect regarding bacterial contamination in transportal technique and TT for ACL-R.

Type of study
Randomized controlled study.

Patients and methods
A total of 80 patients who preceded arthroscopic ACL-R in Assiut Arthroscopy and Sport Injuries Unit in Assiut University Hospital between March 2021 and September 2021 were included in the study. The mean age of the patients was 26 years. Of the patients, 68 cases were males and 12 cases were females. Thirty-five patients underwent the procedure using the TT technique and 45 patients by the AMP technique, through computed randomization. Cotton swabs had been taken of the subcutaneous tissue at the anteromedial portal track in transportal technique and TT before and after instrumentation and femoral tunnel drilling; a control sample was taken from anterolateral track in both techniques.

Results
There were no positive swabs in both TT and transportal technique in all patients included in the study.

Conclusion
There is no effect of changing multiple instrumentation on bacterial contamination in transportal technique and TT for ACL reconstruction.

Keywords:
anterior cruciate ligament reconstruction, transportal techniques and swabs, transtibial

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Introduction

One of the most commonly performed orthopedic surgeries is anterior cruciate ligament reconstruction (ACL-R) [1]. Infection is a rare complication after arthroscopic ACL-R with reported prevalence ranging from 0.14 to 1.7% [2]. One of the most serious complications after an ACL reconstruction is septic arthritis [3].

The *Staphylococci* are the most frequent infection-causing agents. *S. epidermis* is responsible for 50% of incidences (coagulase-negative staphylococcus), followed by *S. aureus* [4].

The rate of infection after ACL reconstruction is as previously reported in the literature. Maletis *et al*. [5] reported an overall rate of infection of 0.48% after 10 626 ACL reconstructions, while Barker *et al*. [6] reported a rate of 0.58% in 3126 patients. Judd *et al*. [7] reported a rate of 0.68% in 1615 ACL reconstructions, compared with an overall rate of 0.75% in 801 ACL reconstructions reported by Katz *et al*. [8]. The risk for orthopedic device-related infection is 1–2% [9].

Intra-articular corticosteroid injection, systemic corticosteroids, and immunocompromised state are risk factors common for infection following ACL reconstruction [10]. After ACL-R, surgical site infection (SSI) rate was 0.48%. 0.32% in deep SSIs

was identified and 0.16% in superficial SSIs. SSIs are more in hamstring tendon autografts than bone patellar tendon bone autografts. No difference in SSI incidence was identified between allografts and bone patellar tendon bone autografts [11].

Graft type, operative time, tourniquet time, foreign body load, and drains are also risk factors for ACL-R [11].

Regarding exogenous sources for bacterial contamination, Parada and colleagues identified the cannulated portion of the screwdriver used to insert the tibial screw and sheath as the source of infections with hamstring tendon grafts [5].

Presurgical preparation is a very important step in the limiting of contamination and preventing infection [10]. Graft soaking in antibiotics decrease the risk of infection [12].

Popular, convenient, and cheap methods of collecting samples for microbiological analysis are sterile swabs [13].

Patients and methods

Our study included 80 patients who had surgical indication of ACL-R, who came from March to September 2021 to our Arthroscopic and Sport Injuries Unit. Cases were divided into two groups using computer-based randomization. Thirty-five cases underwent the procedure by the TT technique and the other 45 cases used the AMP technique. We used computer software SPSS, version 20 (Based in Chicago, SPSS Inc. is a leading global manufacturer of software used in data analysis, reporting, and modeling. Its products include Customer Centric).

All patients signed an informed consent.

(1) Inclusion criteria: (a) Age 18–40 years, (b) isolated ACL injury, (c) nondeformed knee.
(2) Exclusion criteria: (a) Patient age: less than 18 years and more than 40 years old' (b) other knee injuries (e.g. PCL), (c) deformed knee (e.g. genu valgus), (d) immunocompromised patients, for example, diabetes mellitus, on steroids, (e) Bad skin condition of the knee, for example, skin bullae, and (f) revision ACL cases.

Sample size calculation

Total coverage of all eligible cases – fulfills the predetermined inclusion criteria – have been admitted to our Arthroscopic Unit within 6 months period in 2021 from March to September. According to Statistics of Arthroscopy and Sport Injuries Unit in Assiut University Hospital, the expected number of cases had been in the range of (9:15) cases per month, so the total cases were in the range of 56:90 cases.

We used traditional cotton swabs, which had a stem of wood and a pledget of cotton wool at one end. The swab was packed in an individual container, labeled, dated and sterilized, ready for use [14].

After preparation of the patient and sterilization of instruments and swabs, the first swab had been obtained from the subcutaneous tissue just after skin incision at the anteromedial portal track in the AMP technique and in the TT technique and the second swab had been taken after instrumentation and femoral tunnel drilling just before skin closure.

The third swab, the control sample had been taken at anterolateral track in both techniques (Fig. 1). Swabs of every case had been put in its container in an accurate manner.

We sent all specimens to the Microbiology Lab in the Department of Clinical Pathology in our Assiut University Hospital for aerobic, anaerobic, and fungal cultures to be placed into Amies transport media (Becton Dickinson, Franklin Lakes, New Jersey, USA) (Fig. 2). Bacteria cultivation in agars in the lab in our study took about 10 days.

All cases had been followed the same infection control regimen of antibiotic preoperative and postoperative (second-generation cephalosporin).

All operations were performed by the first (M.A.R.) and the third (H.K.) authors at a single institution.

Ethical approval: 'Committee of Medical Ethics' of the Faculty of Medicine, Assiut University

Figure 1

Swab taking of anteromedial portal track.

reviewed and approved the research. Committee reference IRB no: 17101004/2020. Clinical trials ID: NCT04100837.

Method of fixation in our study

Femoral fixation: in our study, in the TT technique we used endobutton and in the AMP technique we used bioabsorbable screws (Fig. 3a, b).

Tibial fixation: in our study, in the TT technique we used titanium screws (Fig. 4); in the AMP techinque we used bioabsorbable screws (Fig. 5).

Statistical analysis

Data were collected and analyzed using SPSS (Statistical Package for the Social Science, version 20, IBM, Armonk, New York, USA). Quantitative data with normal distribution are expressed as mean ± SD) and compared with Student's *t* test. Nominal data are given as number and percentage. χ^2 test was implemented on such data. Level of confidence was kept at 95% and hence, *P* value was considered significant if less than 0.05.

Results

Swab results of the studied groups and operative time

In our study, all swabs obtained from those patients showed no growth for aerobic and anaerobic bacteria. Mean operative time of those patients who underwent the transtibial technique (TT) was 55.57 ± 7.64 min, while the mean operative time of the transportal group was 55.33 ± 5.42 min with insignificant difference between both groups (*P* = 0.89) (Table 1).

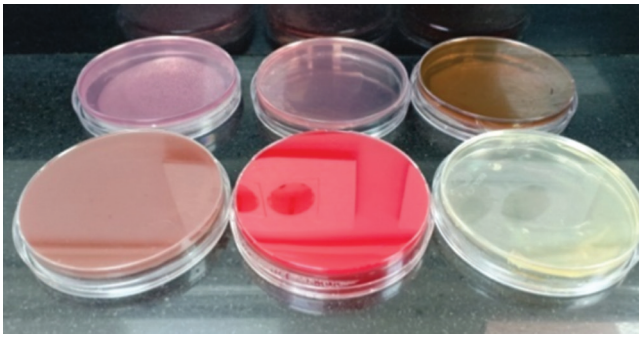
There was no difference in the time of surgery between the two techniques of ACL-R (Fig. 6).

Age, sex, and time interval between injury and surgery of studied groups

Mean age of those patients who underwent the TT was 26.45 ± 5.14 years, and the majority (80%) of them was males while the mean age of the transportal group was 26.26 ± 5.51 years and the majority (88.9%) of them was males. Both techniques had insignificant differences regrading age (*P* = 0.87) and sex (*P* = 0.21).

Also, both groups had insignificant difference as regards time interval between injury and surgery [34.67 ± 22.87 vs. 38.90 ± 21.21 (month), *P* = 0.09] (Table 2).

Figure 2

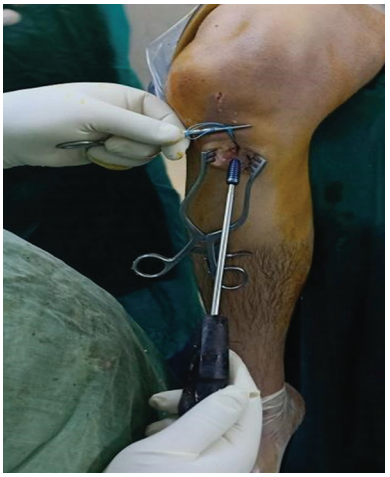


Amies Transport Medium (Becton Dickinson, Franklin Lakes, New Jersey, USA).

Figure 3

(a and b) Fixation of ACL graft in femoral tunnel in transportal technique by bioabsorbable screws. ACL, anterior cruciate ligament.

Figure 4



Fixation of ACL graft in tibial tunnel in transtibial technique by titanium screws. ACL, anterior cruciate ligament.

Mechanism of injury and the affected side among the studied patients

In both groups, the most frequent mechanism of injury was sport injury (51.4% of transtibial group and 55.6% of transportal group), while traumatic injury was present in 17 (48.6%) and 20 (44.4%) patients of the transtibial and the transportal group, respectively. Regarding the affected side, right side was frequently

Figure 5

Fixation of ACL graft in tibial tunnel in transportal technique by bioabsorbable screws. ACL, anterior cruciate ligament.

affected in both groups (51.4% of the transtibial group and 51.1% of the transportal group) while the affected left side was present in 17 (48.6%) and 22 (48.9%) patients of the transtibial and the transportal group, respectively (Table 3).

Both techniques had insignificant differences regarding the mechanism of injury (P = 0.44) and affected side (P = 0.06).

Clinical and radiological data among the studied patients

All patients had positive Lachman test with normal findings on a plain radiograph. It was found that 17 (48.6%) patients of the transtibial group and 25 (55.6%) patients of the transportal group had positive anterior drawer test.

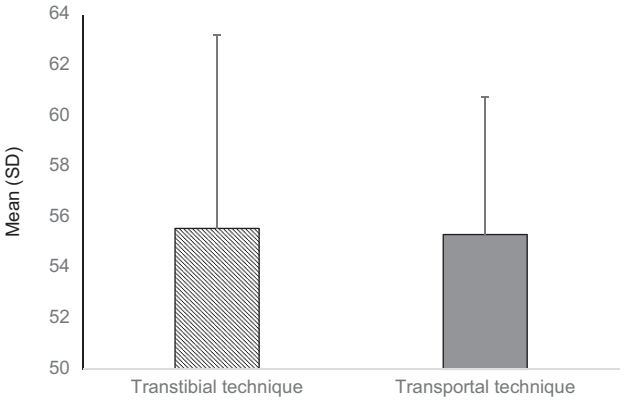
As regards MRI findings, it was found that majority (77.1% of the transtibial group and 57.8% of the transportal group) had complete ACL tear while partial ACL tear present in eight (22.9%) and 19 (42.2%) patients of the transtibial and the transportal group, respectively (Table 4). Both techniques had insignificant differences regarding clinical and radiological data (P > 0.05).

Discussion

The purpose of this study is to determine the effect of multiple instrumentation changing in transportal technique and TT during ACL-R as regards bacterial contamination.

We hypothesized that multiple instrumentation changing in ACL-R techniques make the tunnel potentially contaminated.

Figure 6



Mean operative time of studied patients based on the technique of reconstruction.

Table 1 Operative time and swab result of the studied patients

	Technique		*P*
	Transtibial (*n*=35)	Transportal (*n*=45)	
Operative time	55.57±7.64	55.33±5.42	0.89
Swab result			-
No growth (%)	35 (100)	45 (100)	

Data expressed as frequency (percentage) and mean (SD). *P* value was significant if less than 0.05.

Table 2 Age, sex, and time interval between injury and surgery of studied groups

	Technique		*P*
	Transtibial (*n*=35)	Transportal (*n*=45)	
Age (years)	26.45±5.14	26.26±5.51	0.87
Sex [*n* (%)]			
Male	28 (80)	40 (88.9)	0.21
Female	7 (20)	5 (11.1)	
Time interval (months)	34.67±22.87	38.90±21.21	0.09
Range	3-63	4-61	

Data expressed as frequency (percentage) and mean (SD). *P* value was significant if less than 0.05.

The key finding of this study is that there is no effect of multiple instrumentation changing in transportal technique and TT during ACL-R as regards bacterial contamination in 80 cases in our thesis. All swabs showed 'no growth' of bacterial contamination.

Demographic data findings: sex, age prevalence, and time interval between injury and surgery. In our study, only 12 females were found, which represents 15.5%. The Swedish National Anterior Cruciate Ligament Register shows that the female to male ratio in the register is 42: 58 [15]. In our study, this female was injured during indoors activity, while the Swedish National Anterior Cruciate Ligament Register reported that 36% of the female patients were injured during sport practicing [15]. This is the reflection that the females in our community are less

Table 3 Mechanism of injury and affected side of studied patients

	Technique		*P*
	Transtibial (*n*=35) [*n* (%)]	Transportal (*n*=45) [*n* (%)]	
Mechanism of injury			0.44
Sport	18 (51.4)	25 (55.6)	
Trauma	17 (48.6)	20 (44.4)	
Affected side			0.06
Right	18 (51.4)	23 (51.1)	
Left	17 (48.6)	22 (48.9)	

Data expressed as frequency (percentage) and mean (SD). *P* value was significant if less than 0.05.

Table 4 Clinical and radiological data of studied patients

	Technique		*P*
	Transtibial (*n*=35) [*n* (%)]	Transportal (*n*=45) [*n* (%)]	
Positive Lachman test	35 (100)	45 (100)	-
Positive anterior drawer test	17 (48.6)	25 (55.6)	0.34
Normal radiograph	35 (100)	45 (100)	
MRI findings			0.06
Complete tear	27 (77.1)	26 (57.8)	
Incomplete tear	8 (22.9)	19 (42.2)	

sport practicing. The mean age in the study at the time of ACL reconstruction was 26.35 (21–32) years. The same parameter was 28 years +9 in the Swedish ACL Register [15]. The UK National Ligament Registry reported in 2015 that the mean age at surgery was 30 years [16]. In our study, both groups had a small difference as regards the time interval between injury and surgery, a range of 3–63 months in TT and of 4–61 months in AMP. Various authors suggest that ACL-R be performed at least 3 weeks after injury to avoid arthrofibrosis. More important than time alone, objective criteria including perioperative swelling, edema, hyperthermia, and ROM are important indicators of when surgery should be performed and these signs are also predisposing factors for infectons if surgery is done early [17].

Duration of surgery

In our study, the mean operative time of those patients who underwent TT technique was 55.57 ± 7.64 min while the mean operative time of AMP group was 55.33 ± 5.42 min with insignificant difference between both groups (P = 0.89). Results, on average, The German Orthopedic Surgeons show that differences between high-volume and low-volume surgeons, respectively (55 vs. 71 min) [18]. In double undle technique, duration of surgery range from 65 to 125 min [19] with increased operative time and increased possibility of infection [11].

Graft selection

In our study, we used hamstring autografts for the reconstruction of all operations in both techniques. Judd and colleagues found a higher incidence of infection (11 of 193, 5.6%) in hamstring versus 0 of 217 in patellar tendon. This may be due to the soft tissue injury during hamstring harvesting and subcutaneous positioning of the metallic construct [7].

No increased clinical risk of infection with the use of allograft tissue compared with autologous tissue for primary anterior cruciate ligament reconstruction [20].

Method of fixation

In our study for femoral tunnel fixation, in the TT technique we used endbutton, in the AMP techinque we used bioabsorbable screws. In the AMP technique, bioabsorbable screws touch skin and indentation of the skin after instrumentation, and this may enhance infection (Fig. 3a, b).

In our study for tibial tunnel fixation, in the TT technique we used titanium screws, which does not touch the skin (Fig. 4); in AMP techniques we used bioabsorbable screws (Fig. 5).

Clinical and functional outcomes are similar with metallic interference screws and bioabsorbable interference. Screws, prolonged knee effusion, femoral tunnel widening, and screw breakage are more common with BISs use [21]. Migration is a possible complication of 'bioabsorbable' interference screws [22].

Other paper shows that similar clinical results were associated with bioabsorbable screws and metal screws. Complication rates associated with bioabsorbable screws and metal screws were also similar [23].

Limitations

The following were the limitations of the study: (a) single-center study. (b) Sample size was relatively small. (c) No follow-up for patients.

Conclusion

In this study, we did not find the effect of multiple instrumentation changing in both transportal technique and TT during ACL-R as regards bacterial contamination.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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