

**RESEARCH ARTICLE**

# Comparison of Three Different Methods of Skin Closure in Anterior Midline Incisions of the Knee

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*Research performed at Shahid Ghazi Teaching Hospital, Tabriz University of Medical Sciences, Tabriz, Iran**Received: 24 January 2014**Accepted: 22 April 2014***Abstract**

**Background:** Few clinical trials have studied the functional and cosmetic outcomes of different closure techniques of surgical incisions. Skin wound and incision closure methods may influence the healing process and cosmetic outcome. The present study aims at comparing three different suture techniques of skin closure.

**Methods:** In a clinical trial, sixty patients with anterior cruciate ligament reconstruction surgery were studied. At the end of the operation and after subcutaneous tissue closure, the skin incision was divided into three equal parts. Each part was randomly sutured using one of three methods: simple, vertical mattress, or semisubcuticular suture. After six months follow-up, we took a photograph of the healed wound in each individual. The cosmetic outcome was evaluated and rated by three orthopedic surgeons according to the visual analogue scale (zero to 10). During the study, wounds were followed up regularly for dehiscence, infection or abnormal discharges.

**Results:** There were no significant differences between cosmetic results of different suturing methods. The mean and standard deviation of VAS scores obtained from three different observer were  $5.62 \pm 1.39$ ,  $5.62 \pm 1.13$ ,  $5.65 \pm 1.29$  for the simple suture;  $6.05 \pm 1.33$ ,  $6.13 \pm 1.01$ ,  $5.93 \pm 1.02$  for the vertical mattress technique and  $5.72 \pm 1.82$ ,  $5.81 \pm 0.97$  and  $5.77 \pm 0.99$  for the semisubcuticular method. The overall agreements between observers were weak to moderate.

Slight superiority of the cosmetic outcome of semisubcuticular sutures was not statistically significant.

**Conclusions:** The methods used for suturing an anterior midline incision of the knee does not seem to affect the final cosmetic outcome and the concept of different surgeons from a favorable cosmetic result may vary considerably.

**Key words:** Cosmetic, Knee surgery, Skin Closure, Suture technique

**Introduction**

Repair technique may play a significant role in keloid formation and development of hypertrophic scar and hyperpigmentation at the repaired site (1). The depth and extension of the wound as well as infection and local irritation could affect the scar and scab formation (1). The wounds and incisions are repaired in different ways depending on various parameters. Several studies have confirmed the effects of repair technique, patient variables and wound

type on cosmetic outcomes (2). Surgical incisions are generally closed with sutures (Nylon, polydioxanon, polypropylene) by placing tissue layers of dermis and epidermis together and a quick recovery of the wound is generally obtained (3).

Suture type and technique are significant factors that may affect wound closure outcomes (4). Choosing the right technique and material typically depends on the surgeon's preference. Other than some trials evaluating the functional and cosmetic outcomes of tissue

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**Figure 1.** Skin closure with three different suturing methods including simple, vertical mattress and vertical semisubcuticular methods.

adhesives (5-9), there are few clinical trials exclusively focused on cosmetic outcomes of incisions around the knee. Since wound and surgical incisions repair seems to affect recovery process, the present study was aimed to evaluate three different repair techniques in patients undergoing knee surgery.

### Materials and Methods

In a clinical trial, we studied sixty patients who underwent arthroscopic anterior cruciate ligament reconstruction by bone-patellar-tendon-bone autograft technique. An anterior midline incision was used to harvest the graft. In each patient, the surgical incision was divided into three equal parts and each part was repaired randomly using a different method. Nylon 3/0 sutures were used in all cases.

Inclusion criteria encompassed all patients undergoing ACL reconstruction with BPTB graft without any age limit. Exclusion criteria were history of previous surgery, revision cases, vascular disorders, systemic diseases such as diabetes, rheumatologic disorders and other skin diseases and allergy to the sutures material. The ethical research committee of Tabriz University approved the study and a written consent was obtained.

### Skin closure methods

We used the anterior midline approach in order to harvest the patellar tendon graft. At the end of operation and after subcutaneous tissue repair with Vycril sutures, skin incision was divided into three equal parts and each part was randomly sutured by one of the simple, vertical mattress or vertical semisubcuticular suture techniques.

**Simple suture:** The key to use this technique is to evert the wound edges, which requires that the needle enter the skin at a 90-degree angle approximately 1-2 millimeters from the wound edge. After penetration, the needle should be redirected to proceed at a slightly oblique angle away from the wound edge to the desired depth and then across to the other side of the wound, where its course should follow a mirror image of the first side (2).

**Vertical mattress suture:** The vertical mattress stitch



**Figure 2.** Final outcome six months after surgery.

is placed in a "far-far-near-near" order of bites. The "far-far" loop enters and exits the skin surface at a 90 degree angle, some 4mm to 8mm from the wound margin. It passes relatively deeply into the dermis (2). The "near-near" loop enters and exits the skin surface one to two millimeters from the wound margin, traversing the wound at a depth of one millimeter. Because of the precise degree of control that the vertical mattress stitch requires, bites must be symmetrical, especially the depth of the near-near loop, or the wound will invariably misalign and heal with a "shelf" on one side (2). The knot is tightened only until sufficient opposition and eversion is achieved.

**Vertical semisubcuticular suture:** Semisubcuticular sutures are placed totally within the dermis in a vertical orientation in one side, and like a vertical mattress far and near method on the other side where the suture enters and exits.

Intravenous cefazolin was prescribed to all patients for 48 hours. Physiotherapy and ROM was started in the second day. All patients were visited on the first and second weeks for wound infection or other skin complications. Patients were under close observation during a 6-month period following surgery (Figure 1).

Visual analogue scale was used to study and rate the cosmetic outcomes (10). Three orthopedic surgeons scored the cosmetic outcome of each wound independently using a 0-10 scale system in two different episodes (zero and 10 indicates the worst and best outcome, respectively). Digital images of scars were taken using a digital camera when the patients were visited at six months after operation ( Figures 1 and 2). The ratings were according to a digital photograph sent to the surgeons.

SPSS16 statistical software (SPSS Inc., Chicago, IL) was used in all statistical tests. Once observers' results were recorded, the data were descriptively analyzed using central descriptive statistical methods (mean) and distribution (standard deviation and variance). In order to refer to agreement level of observers, Kappa statistical test was calculated. For assessing the mean cosmetic scores in different types of sutures techniques ANOVA test was used. In all statistical tests, a P value

**Table 1. Classification of Kappa value report used in our study**

No agreement	0<
Slight agreement	0.0-0.2
Fair agreement	0.21-0.40
Moderate agreement	0.41-0.60
Substantial	0.61-0.80
Almost perfect	0.80-1.00

of less than 0.05 was considered significant. For agreement between observers, we used ICC test. We rated the kappa value according to Table 1.

### Results

All 60 patients who participated in our study finished the six months follow-up period. Table 2 demonstrates the average scores of each suture technique rated by each observer. There were no significant differences between the scores among three techniques ( $P=0.20$ ).

According to the findings, the highest rate of agreement of observers was in the vertical subcuticular method. Detailed information is shown in Table 3. No wound complication including infection occurred during the study.

### Discussion

The ideal wound closure technique should be cost-effective, time-effective, and user-friendly with optimal cosmetic outcomes. An interrupted stitch type with favorable tissue characteristics will reduce local wound complications (5) while superficial wound dehiscence may be reduced by using continuous subcuticular sutures (6,7).

Our study showed that the method of suturing in anterior midline approach of the knee did not affect the final cosmetic results. Furthermore, different surgeons had different perspectives from the cosmetic results of a healed wound. The vertical semisubcuticular approach provided the highest rate of similarity of the scores and agreement between the observers. The lowest rate of

**Table 2. Mean scores of VAS regarding to cosmetic outcome given by the observers to each suture technique**

	Simple suture	Vertical mattress	Vertical subcuticular
First observer	5.62±1.39	6.05±1.33	5.72±1.82
Second observer	5.62±1.13	6.13±1.01	5.81±0.97
Third observer	5.65±1.29	5.93±1.02	5.77±0.99

concordance among observers belonged to the vertical mattress method. Although there was no statistically significant difference, slightly better cosmetic outcomes resulted from the vertical semisubcuticular technique.

In a study conducted by Quinn et al, visual analogue scale was 8.3 for repair with vertical semisubcuticular suture (11). In Ende et al.'s study, the VAS score was 8.6 for the vertical semisubcuticular suture group (12). In the study conducted by Gennari et al., there was no difference between skin adhesive and suture groups considering cosmetic scores (13). Gandham et al. compared conventional and dynamic sliding loop suture techniques and found that there was no significant difference between the intervention methods considering the wounds repair but visual analogue scores had higher values for the sliding loop technique (14).

Angelini et al. found that considering final cosmetic outcomes subcuticular suture was better than the nylon vertical mattress (15). Quinn et al. showed that there is no difference between octylcyanoacrylate and sutures considering optimal wound score (73% versus 68%) and cosmetic score of visual analogue scale (69 mm versus 69mm) (16).

Bernard et al. found that suture group obtained higher score in visual analogue scale in comparison to tissue adhesive (63.3mm versus 47.8 mm) (17). The study concluded that cosmetic outcomes of surgical wounds repaired with standard suture are better than wounds closed with octylcyanoacrylate (17).

There was no difference between skin adhesive and suture groups considering the short-term complications after six months as well as during the one-year follow up period in the study conducted by Gennari et al (13). Gandham et al compared conventional suture and dynamic sliding loop technique and reported one case of infection in every group. Evidences of skin edge necrosis were observed in two patients of conventional suture group (14). In Webster and Davis' study, the wound infection was estimated 8.4% in suture repair (18). Ende et al in their study comparing adhesive bonds and percutaneous absorbable suture for closure of surgical wounds in children did not observe any case of wound dehiscence in the suture group (12). In a study conducted by Ong et al. comparing wound closure using tissue glue versus subcuticular suture for pediatric surgical incisions they did not report any case of rash, wound infection, or wound dehiscence (19). Additionally, Shetty et al. did not report any wound

**Table 3. Configuration of Kappa Value between three observer to each suture techniques**

	Second observer	Third observer
First observer	Simple suture: 0.19	Simple suture:0.17
	Vertical mattress :0.13	Vertical mattress:0.14
	Vertical subcuticular:0.35	Vertical subcuticular:0.22
Third observer	Simple suture:0.61	
	Vertical mattress:0.54	
	Vertical subcuticular:0.67	

infection or dehiscence in repairing with subcuticular technique following closure of hip wounds with metallic skin staples or subcuticular vicryl suture (20).

Although semisubcuticular suture technique brings slightly better cosmetic outcomes than the other methods, statistically we were not able to find any significant difference between these techniques. Further studies are required to completely approve the superiority of one technique over the other.

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