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Original Article

Long-term Results of Ligation of Intersphincteric Fistula Tract (LIFT) Versus Traditional Fistulotomy for Fistula-in-Ano

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Abstract

Objective: **To determine and compare the post-operative outcomes for a LIFT operation and traditional fistulotomy for treatment of anal fistulas.**

Background: **No single technique is appropriate for the treatment of all fistula-in-ano cases; therefore, treatment must be determined by the etiology and anatomy of the fistula, degree of symptoms, patient co-morbidities, recurrence rate, incontinence rate and the surgeon's experience. LIFT is a new technique that has the advantages of anal sphincter preservation and less extensive surgery. This current study compares LIFT with traditional fistulotomy.**

Material and Methods: **We retrospectively studied 64 fistula-in-ano patients who underwent surgery. All cases took place between July 20, 2008 and June 30, 2009. Patient characteristics, including sex, age, fistula-in-ano classification, operative time, healing time, recurrence rate, incontinence rate and any complications, were obtained by reviewing each patient's medical record.**

Results: **Thirty-two patients underwent the LIFT procedure, and 32 patients underwent fistulotomy. The mean patient age was 38.84 ± 9.64 years in the LIFT group and 36.18 ± 12.14 years in the fistulotomy group ($P = 0.337$). The majority of cases were simple fistula-in-ano. Simple fistula-in-ano cases comprised 78.1% of the LIFT group and 81.3% of the fistulotomy group ($P = 1.000$). The fistula tract shape was typically straight (90.6%) and was equally prevalent in both groups ($P = 1.000$). The fistula tract length from anal verge was 3.10 ± 1.78 cm in the LIFT group. The most frequent internal opening site of the LIFT group was at 6 o′ clock (31.3%). The most frequent external opening site of the LIFT group was at 5 o′ clock. The number of external openings was not different between the groups ($P = 0.173$). The healing time was 33.54 ± 8.18 days for the LIFT group and 29.90 ± 9.76 days for the fistulotomy group ($P = 0.290$). The healing rate was 81.2% and the local failure rate was 18.3% in the LIFT group. The recurrence rate was 9.4% in the fistulotomy group, and there was no recurrence in the LIFT group. There were no incontinence cases for either group.**

Conclusion: **The LIFT technique preserves the anal sphincter muscle for fistula-in-ano patients. The procedure is safe, shows minimal complications, no recurrence and no incontinence when compared with traditional fistulotomy.**

Keywords: **Fistula-in-ano, ligation of intersphincteric fistula tract, Fistulotomy**

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Introduction

Although the pathogenesis of fistula-in-ano is known and many surgical techniques have been developed for this condition, recurrence and incontinence rates remain high at 0 - 56% and 0 - 54%, respectively[1]. The majority of fistula-in-ano cases are classified as simple and effectively treated by traditional fistulotomy. If the fistula is complex, fistulotomy is not recommended because there is a chance of recurrence and the potential for incontinence. In the current study, we assessed a new surgical technique referred to as ligation of the intersphincteric fistula tract (LIFT)[2]. The LIFT creates a secure closure of the internal opening, concomitant removal of infected crypto-glandular tissue in the intersphincteric plane and preserves the anal sphincter muscle. A previous study of long-term results showed a success rate of 61% and an incontinence rate of 0%[3] . However, the guidelines of the American Society of Colon and Rectal Surgeons Practice Parameters published in 2011 had no recommendation for the treatment of perianal abscess and fistula-in-ano because the majority of the methodology was obtained from observational studies or case series[1]. No comparative studies between LIFT and fistulotomy have been completed in Thailand. Thus, this present study compared the LIFT technique with traditional fistulotomy. Sophisticated interventions, such as fistulography, endoanal ultrasound, CT scan, and MRI were not included. The long-term postoperative outcomes were analyzed after a minimum follow-up of 2 years.

Material and Methods

This retrospective cohort study of sixty-four patients with fistula-in-ano was designed to determine the effectiveness of the LIFT technique compared to traditional fistulotomy. The patients were each informed of the advantages and disadvantages of the procedure as well as the potential complications and risks prior to surgery. All patients underwent surgery between July 20, 2008 and June 30, 2009. Thirty-two patients underwent the LIFT procedure completed by the author, and 32 patients underwent a traditional fistulotomy completed by another general surgeon. Our hospital does not have an endorectal ultrasound or MRI for identifying the fistula-in-ano type, but the cases were evaluated by clinical examination at the preoperative field, including digital rectal examination and proctoscopy. While at the intra-operative field, hydrogen peroxide was injected through the external opening. Patient data were collected by reviewing each patient's medical records after surgery. Patients who were diagnosed with anal TB, HIV infection, incontinence, local irradiation, or Crohn's disease were excluded.

Postoperative Management and Follow-Up Data

All patients were postoperatively prescribed an anti-inflammatory analgesic, a stool softener, and oral antibiotic for two weeks. There were no diet restrictions. Patients were instructed to complete wound cleaning 2 times a day until the wound healed. All patients were examined at the surgical outpatient clinic by the operating surgeon during the first month and every three to six months thereafter. All patients completed follow-up for at least two years. The following parameters were noted at the visits: healing time, recurrence, clinical fecal incontinence, and any other associated morbidity.

Definitions[1,2,4,5]

Each case of fistula-in-ano was classified as one of two types with the following additional criteria:

1) Simple fistula-in-ano
   - Intersphincteric fistula
   - Low transsphincteric fistula: The fistula tract passes between or just above the subcutaneous external anal sphincter, or the fistula tract passed through less than one-third (30%) of the external sphincter complex.

2) Complex fistula-in-ano
   - High transsphincteric fistulas were defined as one encompassing more than one-third (30%) of the external sphincter complex.
   - Multiple fistula tracts (consisting of more than one fistula tract)
   - Extrasphincteric fistula
   - Horseshoe fistula
   - Recurrent fistula
   - Anterior fistula in females

3) Primary wound healing was defined as complete epithelialization of the wound.

4) Recurrence was defined as a non-healing wound or reappearance of an external opening with persistent discharge after six months.

5) Incontinence was defined as the loss of voluntary control of feces (liquid or solid) from the bowel.

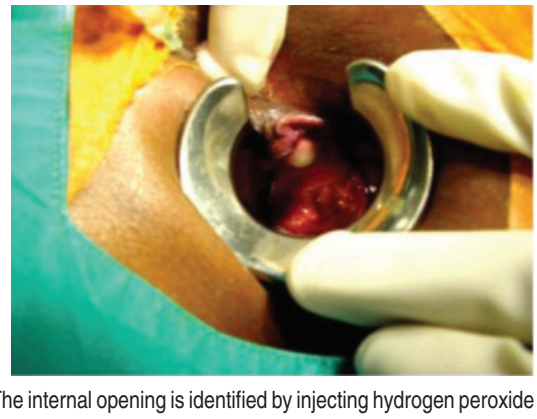
6) Local failures were classified as 1 of 3 types. Type I failures represented residual sinus tracts without an internal opening. Type II failures represented a down staged tract from the intersphincteric incision to the internal opening. Type III failures are complete failures that extend from the previous internal opening to one or more external skin openings.

Statistical analysis

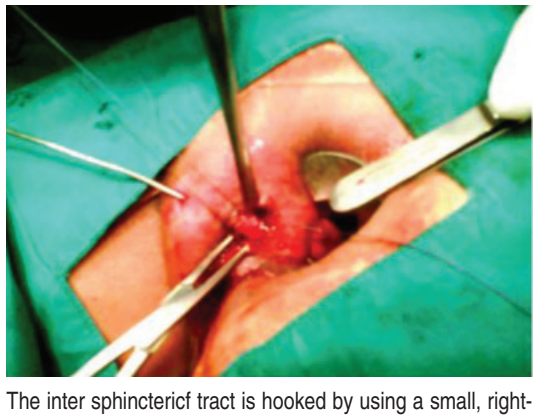
Chi-square or Fisher exact tests were used for the analysis of categorical variables. The Student's t-test was used for continuous variables. Data collected from the database were analyzed using SPSS version 17.0. A *p*-value less than 0.05 was considered significant.

LIFT technique[6,7]

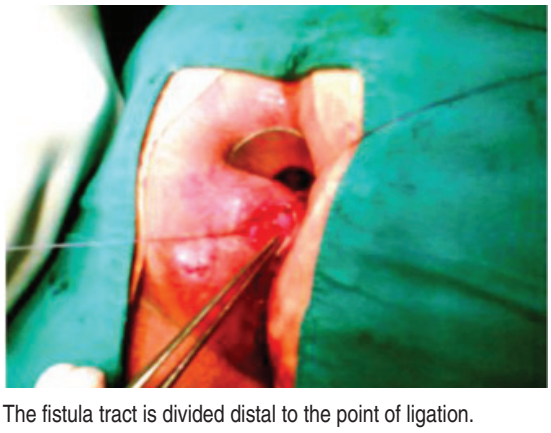
After regional anesthesia, the patient was placed in a prone position with the buttocks taped widely apart. A Fansler anoscope with a 28-mm diameter without a handle was gently inserted. The location of the internal opening was identified by injection of hydrogen peroxide through the external opening or by gently probing the fistula tract. The inter-sphincter groove or plane at the site of the fistulous tract was entered via a curvilinear skin incision using electrocautery. The intersphincteric tract was identified and isolated by meticulous dissection using electrocautery and scissors. Once isolated, the intersphincteric tract was hooked using a small, right-angled clamp. The tract was then ligated close to the internal sphincter with absorbable Vicryl 3/0 sutures. Next, the tract was divided distally to the point of ligation. Subsequently, the external tract was cleared by coring out up to the proximity of the external sphincter complex. Unlike the procedure described by Rojanasakul et al[2], the skin opening was widened and left open[4]. Finally, the intersphincteric incision



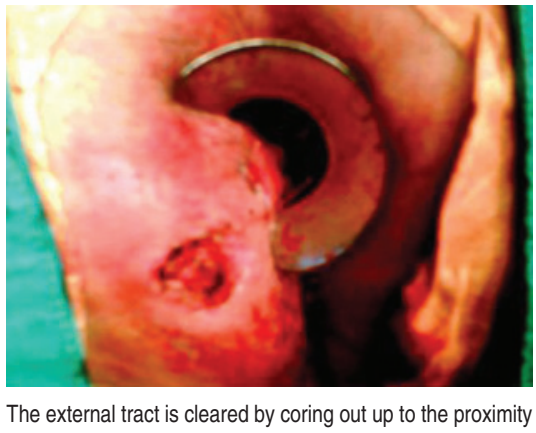
The internal opening is identified by injecting hydrogen peroxide (H_2O_2).



The inter sphinctericf tract is hooked by using a small, right-angled clamp.



The fistula tract is divided distal to the point of ligation.



The external tract is cleared by coring out up to the proximity of external sphincter complex and the skin opening widened and left open for drainage

Figure 1 Demonstration of the LIFT technique.

was loosely re-approximated with interrupted absorbable Vicryl 4/0 sutures. A cored-out wound was left opened for dressing. All pieces of the fistula tract were sent for histopathology. The surgical steps are illustrated in Figure 1.

Fistulotomy technique

The patient was placed in the prone jackknife position or lithotomy position following induction of anesthesia with a regional anesthetic. A probe was inserted from the external opening to the internal opening at the dentate line. The tissue overlying the probe was incised and the granulation tissue was extracted with a curette.

Results

Data for all patients are shown in Table 1. The mean age was 38.84 ± 9.64 years in the LIFT group and 36.18 ± 12.14 years in the fistulotomy group. No significant difference was observed between groups, *P* = 0.337. The male-to-female ratio was 25:7 in the LIFT group and 21:11 in the fistulotomy group. The simple type of fistula-in-ano comprised 78.1% of the LIFT group and 81.3% of the fistulotomy group. The complex type of fistula-in-ano was found in 7 patients (21.9%) from the LIFT group (1 case of high transphincteric fistula, 6 cases of multiple fistula) and 6 patients (18.8%) from the fistulotomy group (2 cases of recurrence, 4 cases of multiple fistula tracts). However,

Table 1 Patient characteristics based on intervention

Variable	LIFT (n=32)	Fistulotomy (n=32)	*P* - value
Age in Years (Mean ± SD)	38.84 ± 9.64	36.18 ± 12.14	0.337
Gender (Male: Female)	25:7	21:11	0.404
Type of fistula in ano (n)			
• Simple	25 (78.1%)	26 (81.3%)	1.000
• Complex	7 (21.9%)	6 (18.8%)	
Underlying disease (n)			
• No	30 (93.8%)	26 (81.3%)	
• Hypertension	1 (3.1%)	5 (15.6%)	
• Diabetes mellitus	1 (3.1%)	0	
• Valvular heart disease	0	1(3.1%)	
Operative time (min)	46.71 ± 20.30	14.21 ± 9.07	0.000
Time of follow up (yrs)	3.40 ± 1.27	2.75 ± 0.90	0.021

Table 2 Details of intraoperative findings.

Variable	LIFT (n=32)	Fistulotomy (n=32)	*P* - value
Fistula tract shape			
Straight tract	29 (90.6%)	29 (90.6%)	1.000
Curve tract	3 (9.4%)	3(9.4%)	
Fistula tract length from anal verge (mean ± SD)	3.10 ± 1.78	-	-
Internal opening site			
• 1 o′ clock	6 (18.8%)	-	
• 5 o′ clock	5 (15.6%)	-	
• 6 o′ clock	10 (31.3%)	-	
• 7 o′ clock	6 (18.8%)	-	
• 11 o′ clock	1 (3.1%)	-	
• 12 o″clock	3 (9.4%)	-	
• 6,12 o′ clock	1 (3.1%)	-	
Number of external openings (mean ± SD) (min-max)	1.34 ± 0.82 (1 - 4)	1.12 ± 0.33 (1 - 2)	0.173

fistula-in-ano type did not significantly differ between groups, $P = 1.000$. The 13 patients (20.3%) classified with complex fistula-in-ano exhibited the following characteristics: 5 patients had multiple fistula and 2 patients had high transsphincteric fistula in the LIFT group; 2 patients had recurrence and 4 patients had multiple fistula in the fistulotomy group. The majority of patients did not have underlying diseases. The operative time was significantly different with a mean time of 46.71 ± 20.30 minutes in the LIFT group and 14.21 ± 9.07 in the fistulotomy group, $P = 0.000$. The average follow-up was more than two years for both groups; however, the follow-up time was longer in LIFT group when compared with the fistulotomy group. The majority of fistula tracts in both groups had a straight tract shape (90.6%) $P = 1.000$. The fistula tract length from the anal verge was 3.10 ± 1.78 cm in the LIFT group. The internal opening sites of the LIFT group were at 6 o′clock (31.3%), 1 o′clock (18.8%) and 7 o′clock (18.8%). The most frequent external opening site of the LIFT group was at 5 o′clock as shown in figure 2. However, the number of external openings was not different between groups, and some patients had more than one external opening.

As shown in Table 3, the mean healing time was 33.54 ± 8.18 days in the LIFT group and 29.90 ± 9.76 days in the fistulotomy group, $P = 0.290$. The recurrence rate was 9.4% (1 simple fistula case, 2 complex fistula cases) and the external opening wound healed in twenty-nine patients (90.6%) in the fistulotomy group. The type I local failure rate was 18.3% (6 simple fistula cases), and the external opening wound healed in twenty-six patients (81.2%) with no cases of recurrence in the LIFT group. The healing rate was not significantly different between groups, $P = 0.474$. There was no cases of incontinence in either group.

Discussion

The principle of fistula-in-ano treatment is identified by the internal opening, eradication of infectious anal gland, adequate drainage, preservation of continence and low recurrence. In the present study, fistula-in-ano treatment was classified into two types, including simple fistula and complex fistula[1]. The main consideration for treating anal fistula is the complexity of the fistula and the amount of sphincter muscle involvement; thus, the surgical options were divided into two categories: 1) non-sparing sphincter muscle techniques, such as fistulotomy or marsupialization with fistulotomy, for simple fistula with success rates of 92% to 97% 8,9; and 2) sparing sphincter

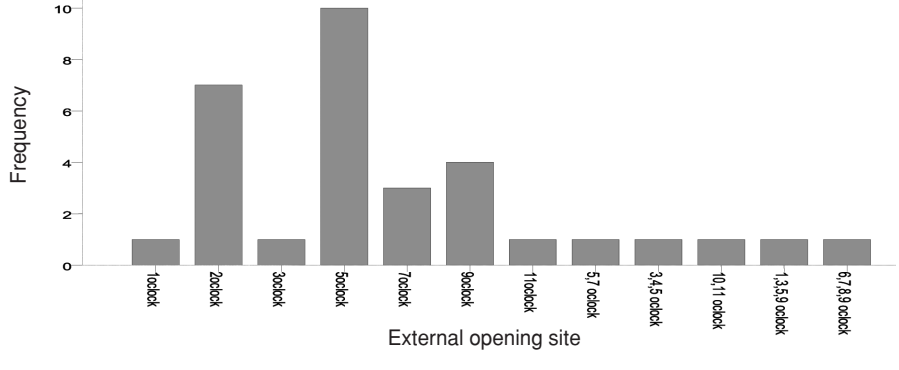


Figure 2 Histogram of external opening sites used for the LIFT technique.

Table 3 Postoperative outcomes

Variable	LIFT (n=32)	Fistulotomy (n=32)	*P* - value
Healing time (days)	33.54 ± 8.18	29.90 ± 9.76	0.290
Recurrence (n)	0	3(9.4%)	-
Incontinence (n)	0	0	-
Local failure (sinus tract) (n)	6 (18.8%)	0	-
Healing rate (%)	81.2%	90.6%	0.474

muscle techniques, such as endoanal advancement flap, fibrin glue injection, anal plugs and the new LIFT technique, for complex fistula with a success rate that varies from 50% to 100%[1]. Our hospital does not have access to sophisticated instruments, such as an endorectal ultrasound or MRI for preoperative localization of the fistula tract; thus, we used clinical examinations. A previous study reported that clinical examinations, such as direct visualization, palpation, and the use of hydrogen peroxide or methylene blue injections into the external opening for identification of tract origin, had success rates greater than 80%[1]. In the current study, the majority of fistula-in-ano cases for both groups were classified as simple and had a straight tract. Our LIFT technique showed a healing rate of 81.2% and the healing time was estimated as 4 - 6 weeks. These findings are similar to those of Rojanasakul et al[2] and Shanwani et al[4] which reported a healing rate of 94.4% and 82.2%, respectively, and a mean healing time of 4 and 7 weeks, respectively. The similarity between studies may be due to the high number of simple fistula-in-ano cases. However, the LIFT group had a significantly longer operative time when compared with the fistulotomy group. Similar to a previous multicenter study that showed a healing rate of 87% and no cases of incontinence, the fistulotomy group showed a healing rate of 90.6% and no cases of incontinence[10]. Sahakitrungruang et al combined marsupialization with fistulotomy and showed a decrease in postoperative pain[11]. In the current study, there were 3 (9.4%) recurrence cases in the fistulotomy group and no recurrence in the LIFT group. The lack of recurrence in the LIFT group is likely due to the prevention of the entry of fecal material into the fistula tract and eliminated the formation of a septic nidus in the intersphincteric space[2]. The current study showed no recurrence cases but had a type I local failure rate of 18.3%. However, the author treated localized wound failure with debridement, curetting and antibiotics. All local wounds were completely healed within two weeks. The management of LIFT failure can by evaluated intraoperatively by using probes and the injection of hydrogen peroxide. Thus, type I failures can be managed with curettage of the tract, silver nitrate application and short-term antibiotics. The local incision can be drained for underlying sepsis. Type II failures can be managed with simple or staged intersphincteric fistulotomy. Type III failures can be managed with a cutting seton followed by a repeat

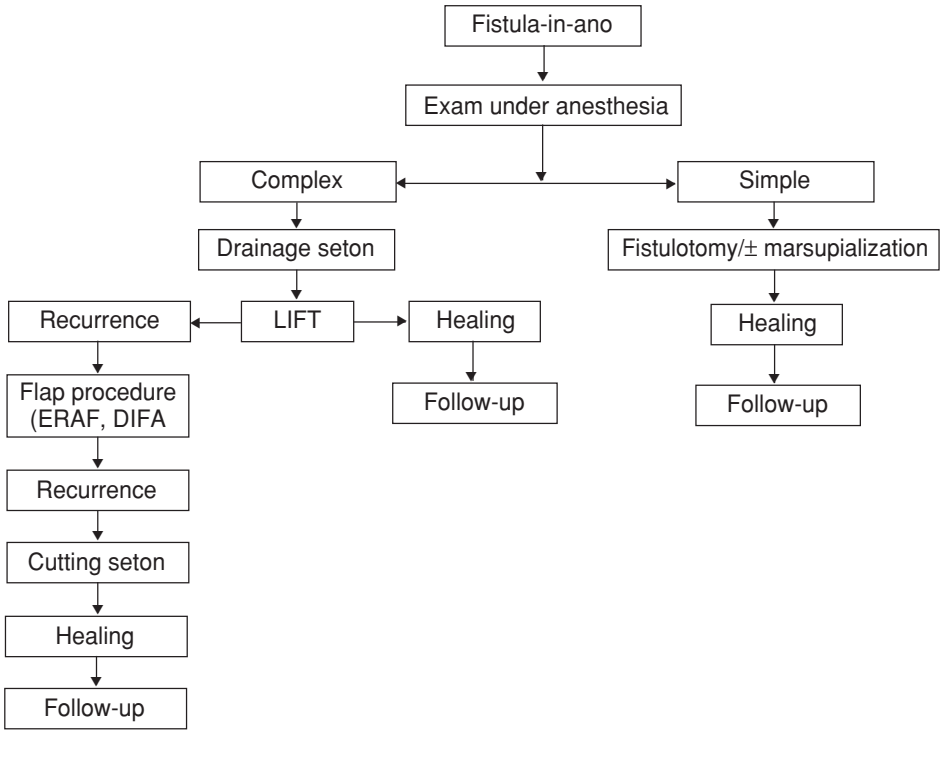


Figure 3 The treatment algorithm. ERAF: Endoanal advancement flap; DIFA: Dermal island flap anoplasty; LIFT: Ligation of intersphincteric fistula tract.

definitive fistula procedure, such as LIFT, fistula plug, or mucosal advancement flap[3,5]. Decreasing the local failure rate can be achieved by coring out the external fistula tract, widening the skin opening and leaving the wound open. In addition, the LIFT technique may prevent a perianal sinus tract (local failure) from developing in the epithelial external tract remnant[4]. Currently, no single technique is appropriate for treating all fistula-in-ano cases. The treatment depends on the surgeon's experience and the type of fistula-in-ano. The extent of anal sphincter muscle division, incontinence rate and healing rate should also be considered. The Standards Practice Task Force of the American Society of Colon and Rectal Surgeons 2011 recommended fistulotomy or fistulotomy with marsupialization for simple fistula types and did not recommend the LIFT procedure for complex fistula types because the data were preliminary[1]. However, in the recent short term comparative study for complex fistula in ano, showed success rate 85%, recurrence rate 19 %, local failure rate 2.4%, no incontinence rate and obesity factor caused failure by univariate analysis[12]. In long term result of LIFT for complex fistula was 62% and no incontinence[3]. There has been many study that suggested inserting a drainage seton in complex fistula, had a success rate vary 62% to 100% and incontinence rate was 0% to 50% depended on secondary procedure (eg. ERAF,DIFA,cutting seton)[1,13,14]. The most common of incontinence is flatus more often than liquid or solid stool. The purpose of drainage seton was to eradicate septic foci by adequate drainage and to promote maturation of the fistula tract around the seton. For flap procedure need to use a high experience surgeon that has recurrence rates 13 % to 56 % and incontinence rate 7 % to 38 %[1]. However, future fistula-in-ano cases should be classified into simple or complex and treated as outlined in the treatment algorithm shown in Figure 3[15].

Conclusion

The postoperative outcomes are not significantly different between the LIFT and fistulotomy groups. However, the advantages of the LIFT technique are preservation of the anal sphincter muscle which prevents incontinence, especially in female patients and cases of complex fistula-in-ano.

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Original Article

Peripheral Vascular Injuries in a Thai Northern Tertiary University Based Trauma Center Level I between 2007 - 2011

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Abstract

Background: **Peripheral vascular injury (PVI) is commonly associated with major trauma especially orthopedics injury. However, detailed descriptive data in Thailand especially in the Northern region were not available.**

Objective: **To describe the PVI over a five-year experience in our institute between 2007 and 2011after trauma team was organized.**

Methods: **All of the PVI records during January 2007 - September 2011 were retrieved from the hospital database. Injury characteristics, time to surgery, severity scoring and operation types were recorded and analyzed.**

Results: **A total of 176 injured patients were included in this study. The median occurrence of injury was 35 cases per year (range 23 - 51 cases). Male was predominant gender (87.5%). Median age (Interquartile range, IQR) was 30 (21 - 43) years. Lower extrimity PVI was occurred higher than upper extremities PVI (59.1% vs. 40.9%). The most common injury sites of upper extremity and lower extremity were radial arteries (12.5%) and popliteal arteries (26.7%) respectively. Of these, 47% underwent vascular repair with conduits (44.3% with reverse saphenous vein graft (RSVG), 2.8% with synthetic PTFE graft) and 29% were repaired without conduit. The amputation rate was 15.3% with median (IQR) of Mangled Extremity Severity Score (MESS) was 7 (7-8) and significant higher than non amputation group (p<0.001). Fasciotomy rate was 6.8%. Significant risk factors of amputation were female (p=0.013), MESS score (p<0.001), skeletal and soft tissue score (p<0.001), limb ischemic score (p<0.001), shock score (p<0.001), lower extremity injury (p=0.014), blunt injury (p=0.011), popliteal artery injury (p=0.018), associated nerve (p=0.006), and associated bone injury (p=0.015).**

Conclusion: **PVI is frequently found injury in the Northern Tertiary University-based hospital. Lower extremity PVI occurred higher than upper extremity PVI. Female gender, MESS score and its components, blunt injury type, sites of injury of lower extremity and popliteal, associated nerve and bone injuries were associated with the risk of amputation.**

Keywords: **Amputation, fasciotomy, Mangled Extremity Severity Score, peripheral vascular injury, popliteal artery injury.**

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Introduction

The results of treatment of peripheral vascular injury depends on many factors such as ischemic time, associated bone and soft tissue injury, patient age and vital sign, and severity of ischemic limbs[1]. In the recent meta-analysis review, the predictive factors of severe lower limb amputation were preoperative hypotension, popliteal artery injury, and associated bone and nerve injury[2]. These factors were integrated in severity scoring of "Mangled Extremity Severity Score" (MESS)[1]. The score were validated in both of lower and upper limb vascular injuries[1,3,4].

In the mid 2006, the specialized trauma team was established in the Department of Surgery, Faculty of Medicine, Chiang Mai University[5,6]. This team has the primary responsibility on all of the peripheral vascular injuries admitted to the Maharaj Nakorn Chiang Mai Hospital except iatrogenic vascular injury. The objective of this study was to present data of the peripheral vascular injury in a five-year experience at our Institute between 2007 and 2011 after the trauma team was set up.

Materials and Methods

Medical records of all patients who were admitted due to peripheral vascular injuries (International Classification of Diseases [ICD 10] coded as S45, S55, S75 and S85) between January 2007 and December 2011 were retrieved. Incomplete medical records, previous operations from other hospitals or iatrogenic injury were excluded. Data included age, gender, site of injury, mechanism of injuries, estimated time from injury to surgery (ischemic time), associated bone or nerve injury, severity of vascular injury measured by MESS scoring system, and all procedures during admission.

Data was analyzed by the STATA software version 11.0 (STATA Inc., College Station, TX). All continuing variable data differences were tested using Student's t test for normal distribution data and reported as mean ± SD or median (25-75 inter-quartile range [IQR]) for non-parametric distribution and tested with Mann-Whitney U test. For categorical variables, Pearson's chi-square was used. Logistic regressions were used to determine amputation risk. Statistical significance was considered when $p < 0.05$.

Results

Data of 202 patients were retrieved from hospital database during a 5 year-period. Twenty six patients were excluded (20 with incomplete medical record, 4 with iatrogenic injury and 2 with vascular reconstruction performed from other hospitals). A total of 176 patients were included in this study. Of these, amputation rate was 15.3% (salvage vs. amputation: 149 vs. 27). Primary and secondary amputation were 19 (10.8%) and 8 (4.5%) respectively. The median incidence rate of injury was 35 cases per year (ranged 23-51 cases). Male was predominant gender (87.5%). Median age was 30 years (IQR 21 - 43). In Table 1, the three most common mechanisms were motorcycle accidence, cut wound and gunshot wound respectively. The occurrence of injury was comparable between upper and lower extremity (41% vs. 59%). However, lower extremity had significantly higher amputation rate than upper extremity injury ($p = 0.01$). The most common injury site of upper extremity and lower extremity was radial (12.5%) and popliteal artery (26.7%) respectively.

In Table 1, amputation rate in five-year range was 7.7 - 23.5%. Amputee patients were younger than non-amputee group (p=0.054). Female had significantly higher percentage of amputation than male (31.8% vs. 10.4%; p=0.005). Motorcycle accident was the major mechanism in amputated patients (87%). About 60% of amputated patients suffered from popliteal artery injury. Ischemic time of amputated patient was significantly longer in amputated patients (p=0.048). Although length of hospital stay was slightly longer in amputated group, there was no statistical significant difference. Regarding operative methods, Forty-seven percent of patients underwent vascular injury repair with conduit (44.3% reverse saphenous vein graft [RSVG], 2.8% synthetic PTFE graft). Twenty-nine percent of patient underwent primary vascular repair without conduit. Secondary amputation rate after RSVG repair was 7.7% (6/78). Superficial femoral artery was ligated in one patient due to unstable hemodynamic and amputation was performed eventually. Thirteen patients had distal artery ligated and limbs were survived. Negative exploration was found in only 1.70% of all injuries. Fasciotomy rate was 6.8% (12/176). Details of patients who had fasciotomy were demonstrated in Table 2. In Table 3, detailing

Table 1 Characteristics of patients

Parameters	Salvage (N=149)	Amputate (N=27)	All (N=176)	*P* value
Age in years (IQR)	30 (21 - 44)	28 (19 - 39)	29.5 (21 - 43)	0.308
Male (%)	134(89.93)	20(74.07)	154(87.50)	0.022
Year (%)				0.289
2007	21(14.09)	2(7.41)	23(13.07)	
2008	29(19.46)	6(22.22)	35(19.89)	
2009	39(26.17)	12(44.44)	51(28.98)	
2010	36(24.16)	5(18.52)	41(23.30)	
2011	24(16.11)	2(7.41)	26(14.77)	
Mechanisms (%)				0.017
Motor cycle accidence	79(53.02)	22(81.48)	101(57.39)	
Cut wound	31(20.81)	0(0.00)	31(17.61)	
Gunshot wound	15(10.07)	1(3.70)	16(9.09)	
Laceration wound	11(7.38)	0(0.00)	11(6.25)	
Fall from height	4(2.68)	1(3.70)	5(2.84)	
Car accident	1(0.67)	1(3.70)	2(1.14)	
Penetrating injury	6(4.03)	0(0.00)	6(3.41)	
Crush injury	1(0.67)	1(3.70)	2(1.14)	
Blast injury	1(0.67)	1(3.70)	2(1.14)	
Site of injuries (%)				0.057
Upper extremity	67(44.97)	5(18.52)	72(40.91)	
Axillary	11(7.38)	1(3.70)	12(6.82)	
Brachial	16(10.74)	3(11.11)	19(10.80)	
Radial	22(14.77)	0(0.00)	22(12.50)	
Ulnar	12(8.05)	0(0.00)	12(6.82)	
Both radial and ulnar	6(4.03)	1(3.70)	7(3.98)	
Lower extremity	82(55.03)	22(81.48)	104(59.09)	
Common femoral	1(0.67)	0(0.00)	1(0.57)	
Superficial femoral	18(12.08)	1(3.70)	19(10.80)	
Popliteal	32(21.48)	15(55.56)	47(26.70)	
Anterior tibial	7(4.70)	2(7.41)	9(5.11)	
Posterior tibial	14(9.40)	4(14.81)	18(10.23)	
Tibioperoneal	1(0.67)	0(0.00)	1(0.57)	
Peroneal	1(0.67)	0(0.00)	1(0.57)	
Dorsalis pedis	1(0.67)	0(0.00)	1(0.57)	
Vascular spasm	7(4.70)	0(0.00)	7(3.98)	
Extremities (%)				0.010
Upper extremity	67(44.97)	5(18.52)	72(40.91)	
Lower extremity	82(55.03)	22(81.48)	104(59.09)	
Type of operation (%)				<0.001
Intraoperative angiogram	5(3.35)	1(3.70)	6(3.41)	
Alone	3(2.01)	1(3.70)	4(2.27)	
With fasciotomy	2(1.34)	0(0.00)	2(1.14)	
Repair with conduit	77(50.33)	6(26.09)	83(47.16)	
Reverse saphenous vein graft (RSVG)	72(48.32)	6(22.22)	78(44.32)	
Alone	52(34.90)	5(18.52)	57(32.39)	
With fasciotomy	11(7.38)	0(0.00)	11(6.25)	
With intraoperative angiogram	9(6.04)	1(3.70)	10(5.68)	
Synthetic graft (PTFE)	5(3.36)	0(0.00)	5(2.84)	
Repair without conduit	51(34.22)	0(0.00)	51(28.98)	
Ligation of vessel	13(8.72)	1(3.70)	14(7.95)	
Primary amputation	0(0.00)	19(70.37)	19(10.80)	
Negative exploration (penetrating injury)	3(2.01)	0(0.00)	3(1.70)	
Injury to surgery time in hour (IQR)	3(1 - 5)	4(3 - 8)	3(1 - 5)	0.053
Length of hospital stay in days (IQR)	16 (4 - 33)	17 (6 - 33)	16 (4 - 33)	0.393

Table 2 Details of patients with primary fasciotomy

No.	Age (yrs.)	Mechanism	Site of injury	MESS	Operation	Time*
1	23	MCA	Popliteal	6	Repair with RSVG	7
2	22	MCA	Popliteal	3	Repair with RSVG	0.5
3	37	MCA	Popliteal	2	Repair with RSVG	0.5
4	24	MCA	Axillary	5	Repair with RSVG	10
5	25	MCA	Axillary	6	Repair with RSVG	14
6	21	MCA	Vascular spasm	2	Intraoperative angiogram	2
7	47	GSW	Brachial	2	Repair with RSVG	4
8	31	MCA	Popliteal	4	Repair with RSVG	4
9	45	GSW	PTA and ATA	4	Repair with RSVG	8
10	34	MCA	Vascular spasm	4	Intraoperative angiogram	4
11	36	Fall	Popliteal	5	Repair with RSVG	7
12	38	MCA	Popliteal	8	Repair with RSVG	8

*Time in hour from accident to operative room, PTA, posterior tibial artery; ATA, anterior tibial artery; GSW, gunshot wound; MCA, motor cycle accidence; MESS, Mangled Extremity Severity Score; RSVG, reverse saphenous venous graft; yrs, years.

Table 3 Detail of Mangled Extremity Severity Score (MESS)

Score	Description	Salvage N=153 (%)	Amputate N=23 (%)	All N=176 (%)	*P* value
	Skeletal/ soft tissue score				<0.001
1	Low energy (stab; simple fracture; pistol gunshot wound)	75(50.34)	1(3.70)	76(43.18)	
2	Medium energy (open or multiple fractures, dislocation)	69(46.31)	8(29.63)	77(43.75)	
3	High energy (high speed motor vehicle accident or rifle gunshot wound)	5(3.36)	12(44.44)	17(9.66)	
4	Very high energy (high speed trauma and gross contamination)	0(0.00)	6(22.22)	6(3.41)	
	Limb ischemia score				<0.001
1	Pulse reduced / absent but perfusion normal (≤ 6hrs)	91(61.49)	0(0.00)	91(52.00)	
2	Pulse reduced or absent but perfusion normal (> 6hrs) or pulse less; paresthesias, diminished capillary refill (≤ 6hrs)	41(27.70)	8(29.63)	49(28.00)	
3	Cool, paralyzed, insensate, numb (≤ 6 hrs)	10(6.76)	11(40.74)	21(12.00)	
4	Pulse less; paresthesias, diminished capillary refill (> 6hrs)	6(4.05)	5(18.52)	11(6.29)	
6	Cool, paralyzed, insensate, numb (> 6hrs)	0(0.00)	3(11.11)	3(1.71)	
	Age group score				0.694
0	< 30 years	88(59.06)	15(55.56)	103(58.52)	
1	30 - 50 years	47(31.54)	8(29.63)	55(31.25)	
2	≥ 50 years	14(9.40)	4(14.81)	18(10.23)	
	Shock score				<0.001
0	SBP > 90 mmHg consistently	115(77.18)	10(37.04)	125(71.02)	
1	Hypotension transiently	27(18.12)	12(44.44)	39(22.16)	
2	Persistent hypotension	7(4.70)	5(18.52)	12(6.82)	
	Total MESS score (IQR)	**4 (3 - 5)**	**7(7 - 8)**	**4(3 - 5)**	**<0.001**

IQR, interquartile range; hrs, hours

proportion of each MESS score was demonstrated. There were statistically significant differences between amputation and non-amputation group on all MESS score parameters ($p < 0.05$) including skeletal and soft tissue score, limb ischemic score, and shock score except age group category ($p = 0.694$). Median (IQR) of total MESS score in amputation group was significantly higher than non-amputation group 7 (7-8) vs. 4 (3-5); $p < 0.001$) (Table 3).

With the logistic regression analysis (Table 4), the

Table 4 Odds ratio of amputation

Risk factors	OR (95%CI)	*P* value
Female	6.16 (1.45 - 26.03)	0.013
Age	0.99 (0.96 - 1.02)	0.639
Skeletal and soft tissue score	17.81 (6.50 - 48.86)	<0.001
Limb ischemic score	4.50 (2.65 - 7.65)	<0.001
Shock score	3.30 (1.81 - 6.01)	<0.001
MESS score	5.13 (2.86 - 9.21)	<0.001
Lower extremity	3.60 (1.29 - 10.00)	0.014
Blunt injury	13.94(1.84 - 105.65)	0.011
Popliteal artery	3.34 (1.23 - 9.11)	0.018
Associated bone injury	4.70 (1.35 - 16.33)	0.015
Associated nerve injury	3.29 (1.42 - 7.65)	0.006

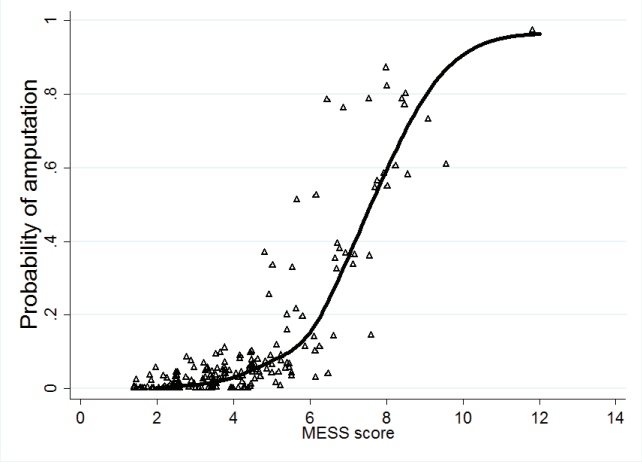

Figure 1 Amputation probability model on Mangle extremity severity score (MESS score)

following factors were correlated with increased risk of amputation: female patients, high MESS score, lower extremities, higher skeletal and soft tissue score, limb ischemic score, shock score, blunt injury mechanisms, and popliteal artery injury. Figure 1 demonstrated probability model of amputation over MESS score. The slope of amputation significantly increased after MESS score more than 6 in our predictive model patient setting.

Discussion

In the present study, the amputation rate for PVI was 15.3%. There are many factors relating with the success of limb salvage in traumatic vascular injury including fracture grading, soft tissue damage and contamination, ischemic time, associated nerve injury, venous damage, compartment hypertension, hemodynamic, mechanism of injury, age, and co-existing disorders[1]. Regarding these factors, the severity grading score of "MESS" was proposed[1]. This scoring system selected four predisposing factors for successful limb salvage prediction including skeletal/soft tissue injury, limb ischemia, shock and age[1]. Regarding the limb ischemic score, the score was doubled if the ischemic time lasted more than six hours[1]. The detailing of score in this study was demonstrated in Table 3. All of the MESS score predictors were significantly different except patient age. This finding might be explained by the unequal distribution of patient age in trauma. Nearly 90% of our patients are in age group under 50 years.

The MESS scoring is primary application on lower limb vascular injury[1,7-10]. The MESS score ≥ 7 was validated to predict amputation with 100% accuracy in retrospective survey and prospective trial[1]. In our setting, however, six patients (4%; 5 in lower and 1 in upper limb) with MESS score ≥ 7 had limb salvage. Therefore, using MESS score for primary amputation should be cautious and decision is based on individual patient especially in upper extremity vascular injury[4,11,12]. However, probability of amputation is highly anticipated when MESS score is more than 6 points (Figure 1).

In addition to MESS and its components, female, lower extremity, blunt injury and popliteal artery injury, and associated bone and nerve injury are the risk of amputation in our setting. These factors are correlated with the previous meta-analysis for traumatic lower extremity vascular injury except female gender[2]. The female patient occupied only 13.5% at all PVI. Unequal size of sample might cause distortion of outcome. The further epidemiologic study for larger sample should be further investigated.

The strength of this study was the pioneer report on PVI after trauma team established in the Northern Tertiary University-based hospital in Thailand. However, there were some limitations in this study. First, details of orthopedic injury was not classified and recorded. Type of injury might distort the amputation outcome[11]. Second, the study is retrospective based on hospital data entering code. There was no death in study population. The registry might miss some severe associated injuries. Prospective collecting data with specific protocol should be initiated in our institute.

Third, the study did not collect injury severity score (ISS). This factor might confound the PVI outcomes.

Conclusion

PVI is frequently found injury in the Northern Tertiary University-based hospital. Lower extremity PVI is higher occurrence than upper extremity PVI. Female, MESS score and its components, blunt injury, lower extremity PVI, popliteal PVI, associated nerve and bone injury are associated with increased risk of amputation.

Conflict of interests

The authors report no conflict of interest relevant to this study.

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Original Article

Efficacy of Intraoperative One-step Nucleic Acid Amplification Assay for Detection of Breast Cancer Metastases in Sentinel Lymph Node

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Abstract

Background: **Accurate intraoperative diagnosis of sentinel lymph node (SLN) metastases enables the selection of patients for axillary lymph node dissections during the same operation, reducing the need for a second operation. To find out whether the one-step nucleic acid amplification (OSNA) assay (Sysmex®) has potential for intraoperative alternative for SLN evaluation, we evaluated the efficacy of OSNA in comparison with frozen section and permanent histological findings. Turn-around time of intraoperative OSNA assay was also considered.**

Materials and Methods: **In total, 111 SLN samples from 62 patients with early stage breast cancers were analyzed. Each SLN was cut into 2-mm sections. Alternate sections were subjected to OSNA assay and histopathological evaluation. Binomial distribution analysis with 95% confidence interval (95%CI) was used for all diagnostic value analysis.**

Results: **The sensitivity and specificity of the OSNA compared with permanent section before discordant case analyses was 84.6% (95%CI, 57.8%-95.7%) and 91.8% (95%CI, 84.7%-95.8%) respectively. Sensitivity and specificity after discordant case analysis were 85.7% (95% CI, 60.0%-96.0%), 92.8% (95% CI, 85.8%-96.5%) and the accuracy was 91.9% (95% CI, 85.3%-95.7%). Turn-around time for OSNA assay was approximately 40 minutes.**

Conclusions: **The OSNA assay was proven to have high accuracy and reliability for evaluation of lymph node metastases in breast cancer patients with acceptable processing time. The assay may be used as an alternate method of frozen section especially in centers lacking of experienced pathologists.**

Keywords: **Breast cancer, nucleic acid amplification assay, sentinel node**

Introduction

Breast cancer causes high morbidity and mortality for women worldwide[1]. Clinical staging after cancer diagnosis is important for deciding further treatment in each patient. Axillary lymph node status is the important predictor for adjuvant treatment and also the prognostic factor of disease. Sentinel lymph node (SLN) biopsy is currently the standard procedure for non-palpable axillary lymph node evaluation. Intraoperative diagnosis of SLNs allows for completion

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of axillary lymph node dissection (ALND) at the time of primary breast surgery if found to be positive for metastatic tumor, eliminating the need for a second surgical procedure with its associated costs, morbidity and patient distress.

Intraoperative evaluation may include frozen section (FS) or touch imprint cytology (IC) or a combination. While the specificity of these techniques is high, the sensitivity varies widely, ranging from 50-75%[2-4]. There is also much variability in the protocols adopted by different laboratories for the final pathologic evaluation of the SLNs in breast cancer. In addition, pathologic assessments examine only a very small amount of the SLN and are subject to inter-observer variability in interpretation, prompting the development of standardized techniques.

To overcome these problems, various molecular techniques have been developed for SLN examination. Using real-time polymerase chain reaction (RT-PCR) technique, a number of specific genes such as *cytokeratin-19 (CK-19), mammaglobin (mam), prolactin inducible protein (PIP), epithelial mucin 1 (MUC1) and prostate-derived ets transcription factor (PDEF)* have been evaluated[5,6]. Molecular testing of SLNs can enable standardized, objective and rapid diagnosis. The one-step nucleic acid amplification (OSNA) (Sysmex®, Inc., Kobe, Japan) detects CK19 mRNA, an established epithelial cell marker for detection of metastatic carcinoma in the SLNs and uses the reverse transcription loop-mediated isothermal amplification (RT-LAMP) method as the amplification technology[7].

To find out whether OSNA has potential for intraoperative alternative for SLN evaluation, we performed the study to evaluate the sensitivity, specificity and accuracy between OSNA, frozen section and permanent histological findings. Turn-around time of intraoperative OSNA assay was also assessed.

Materials and Methods

Patients with newly diagnosed early invasive breast carcinoma at the Department of Surgery, Faculty of Medicine Siriraj Hospital, Mahidol University, during July 2011 - January 2012 were prospectively enrolled in this study. The exclusion criteria were male patients, patients with palpable axillary lymph node or metastatic disease, previous axillary operation or contraindication for SLNB and sentinel lymph node not able to be identified intra-operatively. Ethical approval was obtained through the Siriraj Institutional Review Board before the study start date (Protocol No. 288/2554(EC4)). Informed written consents were obtained from all patients before entry into the study.

Sentinel lymph nodes from breast cancer patients were sent to the Department of Pathology. The nodes were cut and then delivered to the Department of Clinical Pathology for OSNA processing. The first 67 nodes were kept at -70 °C and processed in batch (4 nodes were processed at a time). The next 44 nodes were immediately processed with OSNA assay after receiving the samples and the start-finish time was recorded. The sentinel nodes were processed as follows: each node was weighted and labeled, then sliced along the minor axis into 4 pieces (Figure 1) with 2 mm-width triple-blade type tissue cutter TC-10 (Sysmex®). Slices a and c weighted between 0.05-0.6 g were sent for

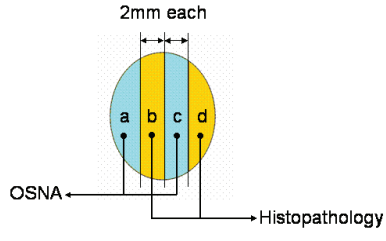

Figure 1 Each sentinel lymph node was cut into four pieces with a special tissue cutter. Two pieces from the node were used for routine intraoperative and histopathological examination (pieces b and d). The rest of the node (pieces a and c) were sent to molecular lab for OSNA processing.

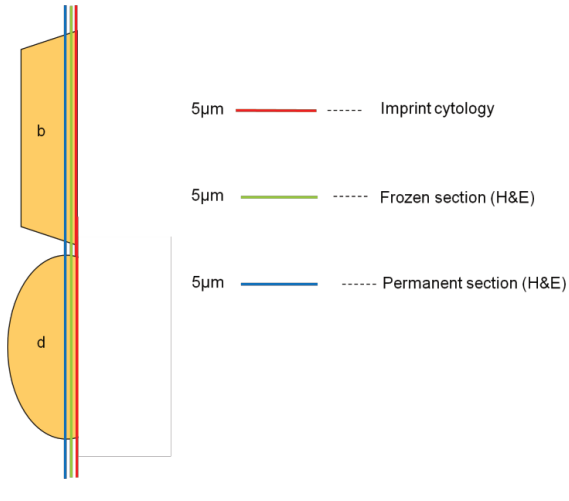

Figure 2 Histopathological examination of slices b and d. Both slices were cut for imprint cytology, frozen section and permanent section examination.

Table 1 Judgment Criteria of Histopathological Examination

1. Positive : "Macrometastasis" or "Micrometastasis" was confirmed by both or either of intraoperative histopathological examination with imprint cytology and frozen section and postoperative histopathological examination with permanent tissue specimen.	
Macrometastasis	Metastasis > 2mm
Micrometastasis	Metastasis > 0.2mm and ≤ 2mm
2. Negative: Both intraoperative histopathological examination with imprint cytology and frozen section and postoperative histopathological examination with formalin-fixed paraffin-embedded sections confirmed "no cancer cell" or "ITC", or either of examination confirmed "no cancer cell" and the other "ITC".	
ITC	Metastasis ≤ 0.2mm
No cancer cell	No cancer cell was observed.

OSNA processing. The remaining two slices (b and d) were subjected to routine intra-operative and post-operative histopathological examination. Imprint cytology was performed on slices b and d. Then both slices were fixed with OTC compound and one frozen section from each slice b and d were prepared. The remaining portions were thawed and fixed again in formalin, embedded in paraffin. Each of slices b and d were sectioned and stained with H & E (Figure 2). The diagnostic criteria of histopathological examination were shown in Table 1.

One step nucleic acid amplification (OSNA) assay was processed as follows: cytokeratin 19 mRNA was used as a target marker for detection of metastasis cancer in sentinel lymph nodes. Before starting to process the lymph nodes, a standard curve, together with a positive and a negative control, must be run using 3 concentrations of CK19 mRNA and reagents from Lynoam BC for CK19 mRNA amplification (Sysmex®). Pieces a and c were homogenized with disposable Lynoprep blade set (Sysmex®) and Polytron® PT1,300D (Kinematica AG, Switzerland) in 4 ml of glycine buffer (Lynorhag, Sysmex) at 10,000 rpm for 60 sec. One ml of the suspension was transferred to a 1.5 ml Eppendorf tube. The tube was then centrifuged at 10,000 xg for 1 min and 200 µl of supernatant was transferred to a new Eppendorf tube. Twenty µl of the supernatant was diluted to 1:100 and 1:10,000 with lysis buffer to achieve the final volume of 200 µl and analyzed with the RD100i system (Sysmex®). For each run, four nodes were analyzed together with a positive and a negative control. Amount of CK19 mRNA copies in sentinel lymph node were calculated from the previously construct standard curve and reported as

Table 2 Judgment Criteria of OSNA Assay

1. Positive: "++," "+" or "reaction inhibited (+i)"	
++	CK19 mRNA (copy number) in the sample (1) is ≥ 5,000 copies/µL
+	CK19 mRNA (copy number) in the sample (1) is < 5,000 and ≥ 250 copies/µL
Reaction inhibited (+i)	CK19 mRNA (copy number) in the sample (1) is < 250 copies/µL , and CK19 mRNA (copy number) in the sample (2) (10-fold diluted solution of the sample (1)) is ≥ 250 copies/µL
2. Negative: "–" and "–L"	
–	CK19 mRNA (copy number) in the sample (1) and in the sample (2) are < 250 copies/µL, and CK19 mRNA copy number in the sample (1) is determined within designated time
–L	Small amount of CK19 mRNA copy number in the sample (1) is detected, but falls in the range of 100 - 250 copies

Note: Total volume of lymph node slices applied to homogenization for 1 test in OSNA assay (4mL lymph node-homogenization buffer) must be less than 600mg. In case of total volume of lymph node slices exceed 600mg, these slices must be divided into 2 or more slices, and these divided slices are individually applied to homogenization and gene amplification reaction. Judgment of the lymph node is negative in case all the measurement results of those divided lymph node slices are "-" or "-L", and judgment is positive in case any of those are "++", "+" or "+i". In case any of slices are judged as "++", the lymph node is judged as "++".

(++), (+i), (+), (-) or (-L) for metastasis (Table 2). The molecular results were compared with results from frozen section and permanent section to evaluate concordant between these results. Turnaround time was recorded from arrival of the nodes in the molecular lab to getting complete results. The analyzer was calibrated to designate samples containing ≥ 250 copies/μl of CK19 mRNA as positive for metastatic tumor. A positive result was further classified into 2 categories: "+" and "++". The "+" signal was generated when the CK19 mRNA number was ≥ 250 copies/μl and ≤ 5,000 copies/μl. A "++" result was generated when the CK19 mRNA number was > 5,000 copies/μl.

Discordant analysis

In case of discordant judgments between OSNA assay and histopathological examination (discordant case) on lymph node basis, the following items were analyzed, and the validity of judgment by OSNA assay is discussed. For negative OSNA but positive histology, expression of CK19 protein in the remaining tissue submitted for histopathological is examined immunohistochemically with anti-CK19 antibody. In case of positive OSNA but negative histology, the remaining portion of the lymph node slices b and d that had been submitted for the histopathological examination are sectioned further to examine the absence/presence of metastatic foci.

Outcome evaluation

The accuracy, sensitivity and specificity of OSNA assay were evaluated compared with histopathological examination as the primary outcome. The turnover time of intraoperative OSNA was analyzed as the secondary outcome.

Statistical analysis

Diagnostic values were determined by comparing the results of the OSNA assay and histopathological examination using statistical program, Confidence Interval Analysis version 2.0, 2000. Binomial distribution analysis with 95% confidence interval (95%CI) was used for all diagnostic values analysis. Mean processing time of intraoperative OSNA was compared using One-way ANOVA test. A *P* value of <0.05 was considered statistically significant.

Results

Patient Characteristics and Sentinel Lymph Nodes

Sixty-four female patients were enrolled in the study and 119 sentinel lymph nodes were investigated by both OSNA assay and histopathology. Two patients

Table 3 Patient Characteristics

Patient Characteristic	Number	Percentage (%)
Enrolled	64	
Excluded	2	
Analyzed	62	100
Age (y)		
Median (range)	48 (28-86)	
< 45	16	26
≥ 45	46	74
Breast surgery		
Conservative	23	37
Mastectomy	39	63
Axillary node assessment		
SLNB	46	74
ALND	16	26
SN identification		
Dye alone	62	100
T classification		
T0	3	5
Tis	9	15
T1mic	3	5
T1a	2	3
T1b	5	8
T1c	14	23
T2	22	35
T3	3	5
Unknown	1	2
Histological type		
Invasive ductal carcinoma	48	77
Invasive lobular carcinoma	4	6
Ductal carcinoma in situ	9	15
Unknown	1	2
Nuclear grade		
1	4	6
2	36	58
3	21	34
Unknown	1	2
Angiolymphatic invasion		
+	10	16
–	27	44
Unknown	25	40
Estrogen receptor		
+	43	69
–	17	27
Unknown	2	3
Progesterone receptor		
+	43	69
–	16	26
Unknown	3	5
HER-2 receptor		
+	12	19
–	38	61
Unknown	12	19

with eight lymph nodes were excluded from data analysis due to previous neoadjuvant chemotherapy. Operation and data analysis were performed on a total of 62 patients. The demographic characteristics of the patients enrolled in the study are presented in Table 3.

OSNA Versus Permanent Section Before Discordance Analysis

Of 111 lymph nodes, 19 nodes were positive (11 were + and 8 were ++) and 92 nodes were negative for OSNA. Comparing to the results of permanent section as gold standard for lymph node metastatic evaluation, 10 samples were discordant. Eight of them were positive for OSNA assay but negative for histopathological examination. Other two were negative for OSNA but positive for histopathological examination. Further discordance analysis was performed in these samples. The results of sensitivity, specificity and accuracy were 84.6% (95%CI, 57.8%-95.7%), 91.8% (95%CI, 84.7%-95.8%) and 91.0% (95%CI, 84.2%-95.0%) respectively. Table 4 showed the results of OSNA versus permanent section before discordance analysis.

Frozen section Versus Permanent Section Before Discordance Analysis

Thirteen lymph nodes were positive for frozen section and permanent section and 98 were negative for both of them. All sample results were concordant between frozen and permanent section. The sensitivity, specificity and accuracy were 100% (95%CI, 77.2%-100%), 100% (95%CI, 96.2%-100%) and 100% (95%CI, 96.7%-100%), respectively. Table 5 showed the results.

Table 4 OSNA Versus Permanent Section Results Before Discordant Analysis

		Permanent Section	
		Positive	**Negative**
OSNA	Positive	11	8
	Negative	2	90

Table 5 Frozen Section Versus Permanent Section Results Before Discordant Analysis

		Permanent Section	
		Positive	**Negative**
Frozen	Positive	13	0
	Negative	0	98

Discordant Case Analysis

The 10 lymph node samples, which were discordant, were further investigated by the pathologists as described in Table 6. The two, negative for OSNA but positive for pathological examination, were positive for CK19 expression in immunohistopathological results. Both of them were also positive when the pathologists reviewed the section. One was diagnosed as micrometastasis. Another one presented as distinct tumor clusters in frozen permanent section, and the pathologists diagnosed positive result. The sample No.

Table 6 Discordant Case Analysis

Node No.	OSNA	Frozen Section	Permanent Section	Frozen Node		CK19 immunohisto-chemistry	Permanent Section		Summary
				Review Section	Smear		Review Section	Re-cut Section	
1	-	+	+	+	-	+	+	+	Micrometastasis
2	+	-	-	-	-	+	-	+	Micrometastasis
3	-	+	+	ITC	Distinct tumor clusters	+	Distinct tumor clusters	-	Distinct tumor clusters
4	+	-	-	red fade	-	ITC	ITC	ITC	Negative
5	+	-	-	-	-	ITC	-	-	Negative
6	+	-	-	-	-	-	-	-	Negative
7	+	-	-	-	-	-	-	-	Negative
8	+	-	-	-	-	-	-	-	Negative
9	+	-	-	-	-	-	-	-	Negative
10	+	-	-	-	-	-	-	-	Negative

2 was positive for OSNA but negative for frozen and permanent section. When this sample was re-cut, it was positive for CK19 expression and permanent section as micrometastasis. Other five samples that were positive for OSNA but negative for histopathological results had the same results after re-cut section. The sample No.4 and 5 were positive for CK19 expression.

OSNA Versus Permanent Section After Discordance Analysis

After discordant case analysis, one discordant data (OSNA: positive/Permanent: negative) was changed into concordant result. The sensitivity, specificity and accuracy were 85.7% (95% CI, 60.0%-96.0%), 92.8% (95% CI, 85.8%-96.5%) and 91.9% (95% CI, 85.3%-95.7%), respectively (as shown in Table 7).

Frozen Section Versus Permanent Section After Discordance Analysis

The sensitivity, specificity and accuracy after discordance analysis were 92.9% (95%CI, 68.5%-98.7%), 100% (95%CI, 96.2%-100%) and 99.1% (95%CI, 95.1%-99.8%), respectively. Table 8 showed the results.

OSNA in Neoadjuvant Cases

The eight lymph nodes from neoadjuvant patients were analyzed using OSNA, frozen section and permanent section. All the results were positive for OSNA, frozen and permanent section concordantly.

Table 7 OSNA Versus Permanent Section Results After Discordant Analysis

		Permanent Section	
		Positive	**Negative**
OSNA	Positive	12	7
	Negative	2	90

Table 8 Frozen section Versus Permanent Section Results After Discordant Analysis

		Permanent Section	
		Positive	**Negative**
Frozen	Positive	13	0
	Negative	1	97

Turnover Time of Intraoperative OSNA Assay

The overall time (from receiving the node until complete data analysis) ranged from 20 to 90 min (mean of 47.3 min). We divided data into three phases of learning experience. After gaining the experience, the mean processing time was reduced (as Figure 3). The first, second and third stage mean time were 53.4, 46.2 and 42.2 min, respectively ($p = 0.001$).

Discussion

With over 30,000 SLNs tested to date globally, the OSNA Breast Cancer System performance is comparable to a very detailed histopathological examination of the SLN. This molecular assay is useful for the intraoperative assessment of SLNs by providing rapid, standardized and objective testing of the lymph nodes. Previous studies have reported the high diagnostic values of OSNA assay. The sensitivity and specificity were range from 91%-100% and 95%-99%, respectively. The concordance between OSNA and pathological results was also high[8-12]. According to our study, the sensitivity was 85.7% (95% CI, 60.0%-96.0%). This may be due to the small sample size.

Only 10 cases from our study showed discordant results. After discordant case analysis, 3 nodes that were previously negative in pathological findings were positive in CK19 expression in immunohistochemical examination. One was micrometastasis in re-cut slices. This case shows that OSNA is more sensitive than permanent histology. Other two presented the isolated tumor cells. The five of eight cases from OSNA positive/Permanent section were negative. These five

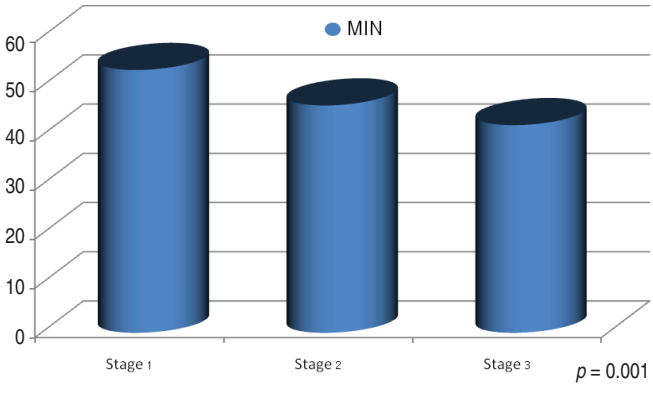

Figure 3 Mean time in the three stages of the learning period

cases seems to be false positive by OSNA. Alternatively, they could be viewed as false negative by even permanent histology. In the evaluation in Singapore and Australia, patient happens to have another sentinel node which was positive by both OSNA and permanent histology, suggesting that OSNA may be more sensitive than permanent histology. False positive results may occur from presence of pseudogenes or benign epithelial cells contamination[9]. In this regard, it might also be observed that this assay adopted the RT-LAMP method developed by Notomi et al[7]. The amplification process is isothermal by means of six primers and can detect CK19 mRNA quantitatively without pseudogenes interference. The assay can differentiate contamination of a few benign epithelial cells and the presence of ITCs from clinically significance by using a verified cutoff value[13].

Two cases of OSNA-/Permanent section+ were positive of CK19 expression in immunohistochemistry. This could be the technical error of OSNA processing. One of the cases has micrometastasis of 0.8 mm by permanent histology on H & E, which is a very small metastasis, while the other case is distinct isolated tumor cells by permanent histology. The latter case had "-L" for OSNA (Table 2), and did not reach the cut-off criteria for positive OSNA. These two cases may be sampling bias where the metastasis presented in the tissue submitted for histology but absent in the tissue submitted for OSNA.

We also evaluated the SNLN from previous neoadjuvant chemotherapy patients. Total 8 nodes were evaluated using OSNA, frozen and permanent sections. The results were concordantly positive. This is a pilot study applying OSNA to evaluate SLNB in patients with breast cancer treated with neoadjuvant chemotherapy. Previous study showed that OSNA had high accuracy in lymph node metastatic evaluation.14 Thus, OSNA could be used in SLNB for breast cancer patients who receive neoadjuvant chemotherapy. Further prospective study should be performed on the role of OSNA in SLN evaluation in breast cancer patients treated with neoadjuvant chemotherapy.

The turnaround time of OSNA was around 40 minutes, which was similar to previous studies[11,15]. OSNA has its particular time of processing. After gaining the experience, the time spending is less[15]. Furthermore, OSNA is feasible and applicable in a hospital where pathologist are not available for frozen section evaluation. One study showed that OSNA method reduces the admission days, duration of surgery, and is cost saving[16].

In conclusion, the OSNA assay proved to have high accuracy and reliability for evaluation of lymph node metastases in breast cancer patients. This tool can be used intra-operatively because the processing time is within acceptable limits. We believe that OSNA will be useful in the hospital where pathologists are not available for frozen section evaluation.

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Original Article

Outcomes and Oncologic Safety of Autologous Dermal Fat Grafting in Breast Conservation Therapy

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Abstract

A novel technique of breast reconstruction in breast conserving surgery (BCS) has been introduced by using autologous free dermal fat graft (FDFG). This study is to evaluate the efficacy of using FDFG.

From January 2007 to December 2010, cross-sectional medical records reviewed a total of 96 women who underwent wide excision and breast reconstruction with autologous FDFG from the lower abdomen. Patients and tumor characteristics, complications, and disease recurrence were obtained. Follow-up radiologic imaging was performed.

The majority of patients (95.8%) received immediate breast reconstruction. The average operative time was 94.2 minutes (range 30-180). The staging was mostly in stage I-II disease (70%). The majority of the patients' status (92, 95.8%) at the last follow-up visit was alive without disease. The overall survival was 98.9% at 199 weeks. The FDFG complications were reported in 7 patients (7.3%). No major morbidity and mortality complications were noted. The graft survival rate was 97.8% at 199 weeks. There was no correlation between the FDFG complications and the patient's characteristics, surgical procedure, timing of reconstruction, size, staging, nor adjuvant treatment.

The use of autologous FDFG for breast reconstruction in BCS is efficient for early breast cancer lesions, with minimal complications and no mortality. This method is valid in detection of local recurrence without interfering with the radiologic imaging reports which ensures oncologic safety.

Keywords: **Autologous free dermal fat graft, breast cancer, breast conserving surgery, breast reconstruction, oncoplastic surgery**

Introduction

Breast cancer is a growing national concern. It is the most frequently diagnosed cancer in women worldwide and also the most common cancer found in Thai women. Breast conservation therapy (BCT) has become the standard treatment for early stage breast cancer. It has been accepted that for most women with stage I or II breast cancer that breast conservation therapy (lumpectomy/partial mastectomy plus radiation therapy) is as effective as mastectomy[1-2]. The goals of BCT are to achieve optimal locoregional control together with acceptable cosmesis. To preserve cosmesis and broaden the options for breast conservation therapy, numerous techniques of breast reconstructions were developed[3-8].

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Recently, a novel procedure was introduced by Kijima et al[9-10] aiming at improving the cosmetic results of the treatment of inner and central breast lesions by using autologous free dermal fat graft (FDFG) after breast conservational surgery. The trial results showed that autologous FDFG was useful for reconstruction with good cosmetic effect, achieving better cosmetic results than transposition of residual breast tissue, and was more convenient than muscle flap grafting, and safer than implantation of foreign materials. Also, the FDFG underwent mild resorption and degeneration of fibrous tissue.

In 2007, the Division of Head-Neck and Breast Surgery, Department of Surgery, Siriraj Hospital Mahidol University, has conducted the technique of breast conserving surgery by using autologous free dermal fat graft. The clinical outcomes and results had yet to be determined. A short-term evaluation of the results was essential to confirm the effectiveness of this technique. The aim of this study was to evaluate the short-term outcomes and oncologic safety of using autologous FDFG in breast conserving surgery.

Patients and Methods

Patients

From January 2007 to December 2010, a total of 96 Thai female patients underwent breast conservation therapy with breast reconstruction using autologous free dermal fat graft at the Division of Head-Neck and Breast Surgery, Department of Surgery, Siriraj Hospital. Patients' data and medical records were cross-sectionally reviewed with approval from the Siriraj Institutional Review Board. Table 1 summarizes the patients' and tumors' characteristics. The breast cancer staging, margin status, and definition of menopause were defined according to the NCCN guidelines Version 1.2013. Staging was obtained from the final pathological report.

Operative procedures

Tumor resection

Wide excision was performed to achieve intraoperative surgical margin of at least 1 cm or greater and included the underlying pectoral fascia. The size of the dissected breast volume was obtained from the official pathological report. The breast tissue

Table 1 Patients' demographic data (N=96)

Characteristics	Mean (SD), Frequency (percent)
Age (yr)	44 (7.8) (26-66)**
BMI (kg/m^2)	22.9 (3.9) (15.7-36.7)**
Menstruation status	
Premenopause	70 (73)
Menopause	27 (27)
Family History	
Breast cancer	11 (11.5)
Ovarian cancer	1 (1)
Medical disease	
Diabetes mellitus	1 (1)
Hypertension	6 (6.3)
Dyslipidemia	4 (4.2)
Clinical presentation	
Breast mass	77 (80.2)
Abnormal mammography	14 (14.6)
Breast pain	1 (1)
Delayed breast reconstruction	4 (4.2)
Breast lesion	
Right breast	49 (51)
Left breast	47 (49)
Location	
Upper outer	48 (50)
Upper inner	14 (14.6)
Central	4 (4.1)
Lower outer	21 (21.9)
Lower inner	9 (9.4)
Axillary surgery	
None	9 (9.4)
SLNB	50 (52.1)
ALND	37 (38.5)
Resected breast tissue	
Length (cm)	7.3 (1.8) (3.3-13) **
Width (cm)	5.8 (1.7) (2-11.5) **
Thickness (cm)	3.4 (0.9) (2-5.5) **
Volume (cm^3)	174.3 (121.3) (24-569.2) **
FDFG volume (cm^3)	87.2 (62.53) (10.3-298.1 **)
Timing of reconstruction	
Immediate	92 (95.8)
Delayed	4 (4.2)
Operative time (minutes)	94 (33.5) (30-180) **

SD= Standard Deviation, ** = range

length, width, and thickness were measured in centimeters and calculated into cm^3 for volume of breast defect. In patients who had a prior incisional or excisional biopsy done, the breast volume was omitted for calculation. All surgeries were performed by surgeons from the Division of Head-Neck and Breast Surgery.

Reconstruction

Breast reconstruction was performed using autologous FDFG harvested from the lower abdominal area. Elliptical skin incision was performed and de-epithelialization of the graft was done by sharp dissection. Further dissection of the abdominal fat was done in an elliptical contour down to the abdominal sheath. The graft size was approximated to the breast volume defect, although the graft size was not routinely documented. The excised FDFG was tailored to achieve the best contour for the breast. Then, FDFG was turned over to allow the graft's dermis in direct contact with the pectoralis muscle so that revascularization may occur. Suture fixation of the graft to the muscle 2-4 corners was performed, followed by skin closure. Placement of closed suction drain was not routinely placed in the breast. A supportive dressing was applied to the graft site without applying excessive pressure. The resected breast volume was calculated using the ellipsoid volume formula as follows: volume (cm^3) = $\pi/6 \times$ length (cm) $\times$ width (cm) $\times$ thickness (cm).

Follow up

Patients who required adjuvant treatment, oncologist and radiologist were consulted. Routine post operative follow-up of radiologic imaging with ultrasound and mammogram was done at six months after completion of adjuvant treatment. Medical records were reviewed up to January 2012 with a median follow-up time of 45 months (range 13-60). Complications of the FDFG were reported as mastitis and further categorized into subgroup of treatment, which were medical treatment alone, incision and drainage, or graft removal. Seroma at the graft was not included as a complication since patients did not require any treatment. Seroma at the abdomen was reported as some patients required aspiration, and some patients had prophylactic closed suction drainage placed in the abdomen. Disease recurrence was classified to recurrent to the ipsilateral breast, contralateral breast, the axilla, and distant metastasis. One patient had recurrence in both ipsilateral breast and bone and was then categorized separately. The status of patients up to the last time of visit was categorized into four groups: alive with no evidence of disease; alive with disease; dead with disease; and dead due to other causes.

Statistical Analysis

Statistical analysis was performed using SPSS statistical software, version 15.0; SPSS, Inc., Chicago, IL, USA. For categorical variables, the Fisher's exact test was applied. Mann-Whitney U test was calculated for each association between continuous variables. Kaplan-Meier curve was used to calculate the survival rate.

RESULTS

A total of 96 female patients underwent BCS with wide excision and reconstruction with autologous FDFG. The patients' demographic data are shown in Table 1. The average age of patients was 44.2 years (range 26-66). All of the patients had disease located in one breast. The average volume of resected breast tissue was 174.3 cm^3. The average calculation for FDFG size was 87.3 cm^3, using the ellipsoid volume formula. The timing of reconstruction was mainly immediate; done in 92 patients (95.8%) and delayed in 4 patients (4.2%). There was no correlation of the timing of reconstruction with the FDFG complications (P= 0.394). The average operative time was 94 minutes (range 30-180), which included the axillary surgery.

The histopathologic features are demonstrated in Table 2. The majority of patients were diagnosed with invasive cancer. There was no correlation of the tumor size to the FDFG complications (P= 0.638). The margin of excision was free of tumor in 69 patients (71.9%), 22 (22.9%) had close margin, and 5 (5.2%) had a positive margin. Eleven patients needed a second operation; 7 (7.3%) underwent re-excision without removal of the FDFG, 1 (1%) needed re-excision twice without removal of the FDFG, and 3 (3.1%) required total mastectomy.

Table 3 shows that the patients were mostly at stage I-II disease. One patient was diagnosed of stage IV cancer. This patient was a known case of invasive ductal carcinoma of the left breast, and had a previous wide excision with ALND performed. Two years later,

Table 2 Histopathologic features

Characteristics	Frequency (percent)
Tumor size	
In situ disease	13 (13.5)
≤ 2 cm	40 (41.7)
2.1-5 cm	39 (40.6)
> 5 cm	4 (4.2)
Nodal status	
Negative	68 (70.8)
4-9 nodes	16 (16.7)
4-9 nodes	9 (9.4)
> 9 nodes	3 (3.1)
Histology	
Ductal carcinoma in situ	13 (13.5)
Invasive ductal carcinoma	78 (81.3)
Invasive lobular carcinoma	2 (2.1)
Invasive papillary carcinoma	2 (2.1)
Malignant phyllodes	1 (1)
Cell differentiation	
DCIS	13 (13.5)
Low grade	15 (15.6)
Moderate grade	51 (53.2)
High grade	17 (17.7)
Angiolymphatic invasion present	13 (13.5)
Perineural invasion present	8 (8.3)
Hormonal status	
ER positive	67 (69.8)
PR positive	67 (69.8)
Her2 positive	22 (22.9)

Table 3 Staging, management, and follow up

Characteristics	Frequency (percent)
Staging	
DCIS	12 (12.5)
Stage I	31 (32.4)
Stage II	37 (38.5)
Stage III	14 (14.6)
Stage IV	1 (1)
Malignant phyllodes	1 (1)
Excision margin status	
Free margin	69 (71.9)
Close margin	22 (22.9)
Positive margin	5 (5.2)
Second operation	
None	85 (88.5)
Re-excision	7 (7.3)
≥ 2 re-excision	1 (1)
Total mastectomy	3 (3.2)
Adjuvant treatment	
Chemotherapy	55 (59.8)
Radiotherapy	83 (91.2)
Hormonal therapy	70 (76.9)
BIRADS score at 6 months	
BIRADS 1	4 (5)
BIRADS 2	44 (55)
BIRADS 3	30 (37.5)
BIRADS 4	2 (2.5)
BIRADS score at latest imaging	
BIRADS 2	28 (51.9)
BIRADS 3	24 (44.4)
BIRADS 4	2 (3.7)

this particular patient had a recurrent ipsilateral breast cancer with bone metastasis. She was then treated with wide excision and FDFG followed by palliative adjuvant treatment. She died ten months later. There was no correlation between the staging of the disease and the FDFG complications ($P = 0.675$). More than half of patients received postoperative adjuvant systemic therapy (chemotherapy in 59.8% and hormonal therapy in 76.9%) and breast radiation therapy (91.2%). There was also no correlation between the adjuvant treatments and the FDFG complications ($P = 0.515$).

Disease recurrence occurred in 7 patients (7.3%), as shown in Table 4. Four patients (4.2%) had the disease recurrence to the ipsilateral breast which was treated with total mastectomy. Two patients (2.1%) had distant metastasis occurred: one to the lung; and the other to the liver. One patient (1%) recurred with an ipsilateral breast cancer and bone metastasis. The average time to disease recurrence was 56 weeks (range 21-145). The majority of the patients' status (92, 95.8%) at the last follow-up visit was alive without disease. Three patients (3.2%) were alive with disease. There were three patients with distant metastasis as previously discussed above. One patient (1%) died with disease, which was the same patient as she was diagnosed in the stage IV disease. The overall survival was 98.9% at the median follow-up of 45 months. The disease-free survival was 95.5% at 1 year and 83.7% at 33 months (Figure 1).

The post operative mammogram at 6 months had a BIRADS score of mostly 2 (44, 55%) (Figure 2) and 3 (30, 37.5%). Two patients (2.5%) had BIRADS score of 4. The first patient was diagnosed of DCIS, and was treated with wide excision with SLNB followed by adjuvant radiotherapy. Two years later, she complained of scar contracture and breast asymmetry. Therefore, the scar excision and delayed FDFG was performed. This patient developed mastitis and was treated with

Table 4 Status, recurrence, and complications

Characteristics	Frequency (Percent)
Status	
Alive without disease	92 (95.8)
Alive with disease	3 (3.2)
Dead with disease	1 (1)
Disease recurrence	
None	89 (92.7)
Ipsilateral breast	4 (4.2)
Distant metastasis	2 (2.1)
Ipsilateral and distant metastasis	1 (1)
FDFG complications	
None	89 (92.7)
Mastitis, medical treatment	2 (2.1)
Mastitis, incision + drainage	1 (1)
Mastitis, graft removal	2 (2.1)
Mastitis + drainage, scar excision and re-DFG	2 (2.1)
Abdominal complications	
None	85 (89.5)
Seroma	8 (8.4)
Bleeding	2 (2.1)

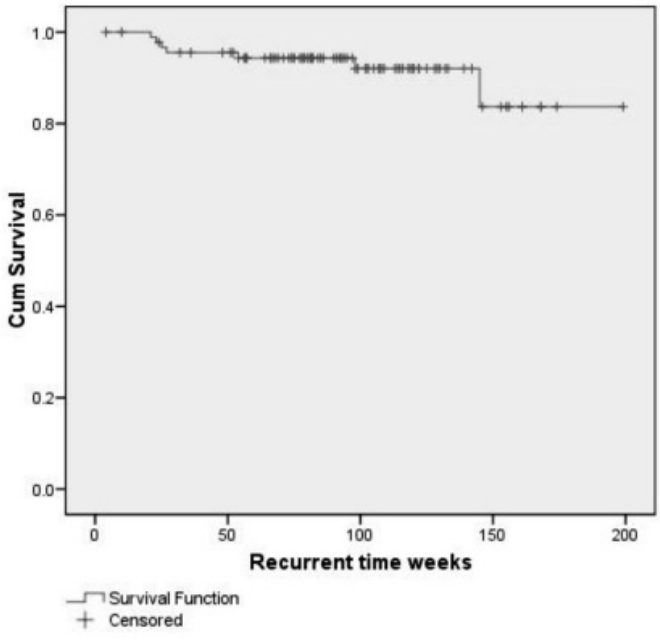

Figure 1 The disease-free survival was 95.5% at 1 year and 83.7% at 145 weeks.

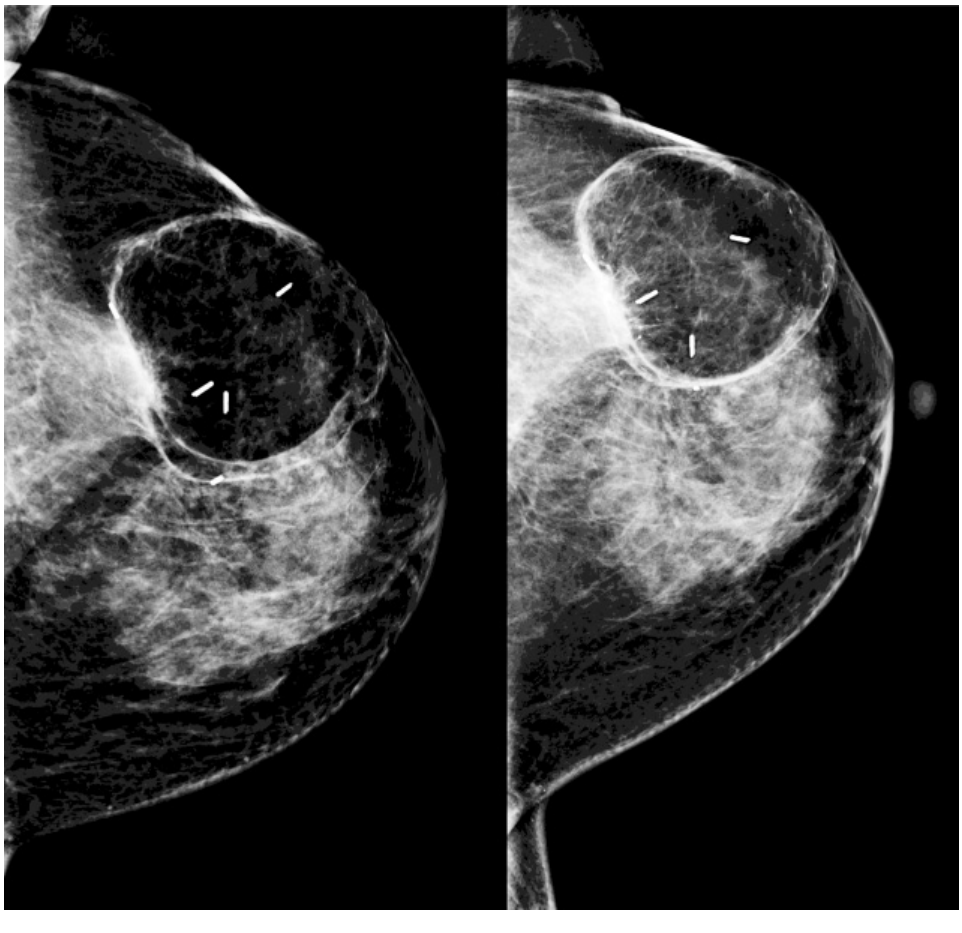

Figure 2 Mammography at 6 months (left) and 24 months (right) post adjuvant treatment. BIRADS score 2

incision and drainage. Her mammogram at 6 months post operation was 4B. The core-needle biopsy was invasive ductal carcinoma. She was diagnosed of disease recurrence to the ipsilateral breast and was treated with total mastectomy.

The second patient with a BIRADS score of 4 was diagnosed of invasive ductal carcinoma of breast and had wide excision with SLNB performed, followed by adjuvant treatment. She then presented with scar contracture and had delayed breast reconstruction performed with FDFG. At 6 months post operation BIRADS score was 4a, core-needle biopsy showed chronic inflammation and fat necrosis. Among the 96 patients, 54 had further follow-up mammogram. The majority score were still BIRADS 2 and 3. The average time to second mammogram was 109 weeks (range 41-190).

The FDFG complications were not seen in the majority of cases (89, 92.7%). Two patients had mastitis which was successfully treated with antibiotics. One patient had mastitis that required incision and drainage while keeping the DFG in situ. Two patients had mastitis which turned into graft necrosis and had FDFG removed. Two patients underwent wide excision and FDFG, and later developed mastitis which was treated with incision and drainage, and later developed scar contracture which was treated with scar excision and re-FDFG. There was no skin flap necrosis, nor nipple-areolar complex complications. No major morbidity and mortality complications were noted at 30-day post operative period. The graft survival rate as detected by ultrasonography was 97.8% at last follow-up visit with excellent patients' satisfaction in term of cosmetic outcome.

Abdominal complications were found in 10 patients. Eight patients had seroma in the donor site, which were treated with aspiration. Due to frequent seroma found in the abdomen, some surgeons preferred to place a prophylactic closed-suction drain in the abdomen in cases of large-size graft. Two patients had bleeding problem at the abdominal wound which was treated with sutures under local anesthesia.

Discussion

Breast conservation therapy (BCT) has become the standard treatment for early stage breast cancer, achieving optimal locoregional control together with acceptable cosmesis. A novel procedure reported by Kijima et al, used the autologous FDFG for immediate breast reconstruction in early breast cancer patients who underwent partial mastectomy, with the disease mainly in the upper inner quadrant of the breast. In this study, the technique of using autologous FDFG was performed in 96 Thai female patients with defects in any quadrant of the breast. We did not find any correlation between the disease location of the breast to the complications, and the cosmesis was satisfactory in all patients. The size of the tumors did not have correlation with FDFG complications such as mastitis.

In this study, about a quarter of the pathological margins were close or positive margins. A large number of cases with close margins were at the anterior or posterior aspect, which sometimes cannot achieve a greater margin. Suggestions for wide excision of the tumor in this study were at least ≥1 cm during dissection. It is possible that, to reduce the rate of close or positive margins during the operation, the margins may be examined histologically to ensure that the margins were free of tumor. The dissection of at least 2 cm beyond the tumor edge was also an option, but a larger FDFG graft would be required and the cosmesis have yet to be determined. All cases with a second operation of re-excision or total mastectomy did not report any FDFG complications. There were also no 30-day morbidity and mortality in this study.

There was no correlation between the timing of reconstruction and FDFG complications. No correlation between adjuvant treatment and FDFG complications was also found. Although a few patients developed disease recurrence in the breasts, all of the recurrence could be detected by radiologic imaging. This implied that the use of FDFG did not interfere with the interpretation of BIRADS score and could detect local recurrence of the ipsilateral breast.

In conclusion, BCS with the use of autologous FDFG for reconstruction is efficient in early breast cancer lesions with minimal complications. This method did not interfere with the radiologic imaging reports to detect local recurrence, which ensures oncologic safety in a short-term period. Evaluations of the long-term aesthetic outcome are warranted in future studies.

Conflict of interest statement: Pornchai O-charoenrat and other co-authors have no conflict of interest.

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Original Article

The Efficacy of Unilateral Approach for Bilateral Decompression and Fusion in Spinal Stenosis with Segmental Instability

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Abstract

Objective: **To evaluate the efficacy of the unilateral approach for bilateral decompression and fusion (UBD & fusion) in spinal stenosis with segmental instability**

Methods: **Retrospective review of patients underwent surgery with unilateral approach for bilateral decompression and fusion during April 2010 and April 2012 was performed. Fifty one patients were included in the study. The visual analog scale (VAS), Neurogenic Claudication Outcome score (NCS), and Prolo Functional and Economic Scales (Prolo score) were used to evaluate all patients preoperatively and at 1-year follow-up. The success of the intervetebral fusion was assessed at 1 year after index surgery. Complications, including adjacent segmental degeneration and instrument failure, were recorded in the postoperative assessment.**

Results: **Fifty one patients who underwent unilateral approach for bilateral decompression and fusion achieved favorable outcome. The VAS, NCS and Prolo score had significantly improved at 1- year follow-up and the fusion rate was 100 percent with no surgical complication.**

Conclusions: **Favorable results from the novel technique "Unilateral Approach for Bilateral Decompression and Fusion" were found. This technique gives an adequate bilateral nerve roots decompression with high successful spinal fusion rate.**

Keywords: **Transpedicular screw fixation, transforaminal lumbar interbody fusion, unilateral Approach for Bilateral Decompression & Fusion (UBD & Fusion)**

INTRODUCTION

Degenerative lumbar disorders are commonly found in the elderly. The disorders feature lumbar disc herniation, lumbar spinal stenosis, spondylolisthesis and segmental instability[9]. Patients are presented with back pain or leg pain together with neurogenic claudication[6,8,9]. When surgical treatment is indicated, decompression of spinal canal and fusion are key procedures. Many surgical techniques have been proposed[1,3,6,9,10].

Unilateral approach for bilateral decompression technique was developed from microsurgical fenestration by McCulloch[9]. This technique needs a laminectomy approach only from one side to perform a bilateral nerve root decompression (Figure 1). Many authors reported high success rate of this

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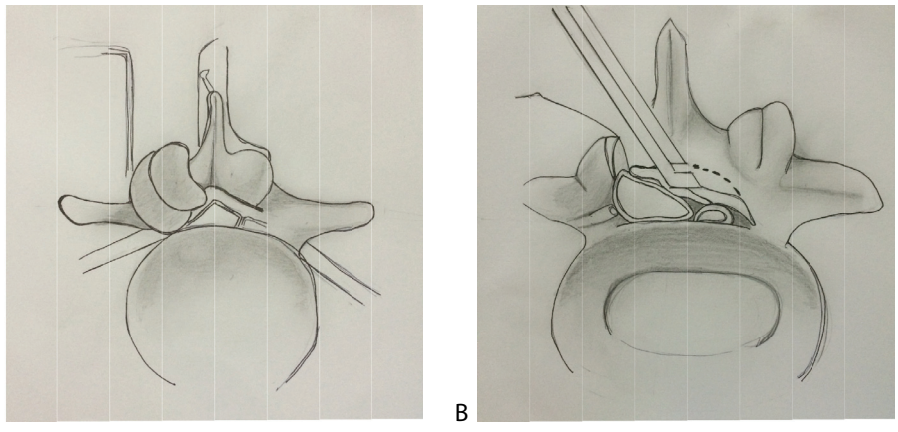

Figure 1 Unilateral approach to more pronounce symptoms side (A); Decompression under microscopic assist for contralateral side (B)

technique[6,8,9,13,14].

Degenerative lumbar spine does not bring only neural compressive symptoms but also segmental instability which needs spinal fusion along with decompression[12,14]. The authors have developed novel less invasive technique for decompress nerve roots, together with stabilizing the spine by an "Unilateral Approach for Bilateral Decompression and Fusion (UBD & Fusion)". The fusion method in this technique is transforaminal lumbar interbody fusion (TLIF).

In this study, we reported an outcome of this technique. The unilateral approach for bilateral decompression and fusion (UBD & Fusion) techniques were performed in patients with lumbar spinal stenosis and spondylolisthesis. The outcomes, including visual analog scale (VAS), Neurogenic Claudication Outcome Score (NCS), Prolo functional and economic scales (Prolo score), were collected. The evidence of interbody fusions was evaluated by plain radiograph in both static and dynamic views. We compared these preoperative parameters with the postoperative results at one year.

Materials and Methods

Patient characteristics and patient selections

Between April 2010 and April 2012, 51 patients (22 males and 29 females) (Table 1) with degenerative lumbar spinal stenosis and spondylolisthesis were treated with unilateral approach for bilateral decompression and fusion by a single surgeon (Tangviriyapaiboon T.) at the Prasart Neurological Institute Hospital, Bangkok, Thailand. The following criteria were used to select patients:

1. Diagnosis of degenerative lumbar spinal stenosis with spondylolisthesis;

2. Patients with back pain or leg pain with neurogenic claudication;

Table 1 Basic characteristic of patients

	N (%)
Gender	
Male	22 (43.14%)
Female	29 (46.86%)
Total	51
Age in years on admission date	
30 - 39	5 (9.80%)
40 - 49	7 (13.73%)
50 - 59	14 (27.45%)
60 - 69	19 (37.26%)
70 - 79	6 (11.76%)
Chief complaint	
Back pain	39 (76.47%)
Leg pain	12 (23.53%)
Level of unilateral approach for bilateral decompression	
L2-3	12 (12.63%)
L3-4	28 (29.47%)
L4-5	44 (46.32%)
L5-S1	11 (11.58%)
Total	95 levels
Level of transforaminal lumbar interbody fusion	
L2-3	6 (10.53%)
L3-4	13 (22.80%)
L4-5	31 (54.39%)
L5-S1	7 (12.28%)
Total	**57 levels**

Table 2 Summary of the Neurogenic Claudication Outcome Score (NCS)

1. How far can you walk before having to stop and rest?			
a) <100 meters	b) between 100 meters and 1 /2 kilometers	c) between 1/2 and 1 kilometers	d) >1 kilometers
2. How long can you stand still before having to sit down?			
a) <5 minutes	b) 5-15 minutes	c) 15-45 minutes	d) as long as I please
3. Once your symptoms arise, you have (rank each) back pain, leg pain, numbness/tingling, heaviness/weakness			
a) severe	b) moderate	c) mild	d) none
4. The symptoms affect the following activities (rank each): sports or activities, household or odd jobs, walking, standing, sitting, sex life.			
a) severely	b) moderately	c) mildly	d) not at all
5. How long must you rest before the symptoms resolve?			
a) >10 minutes	b) 5 - 10 minutes	c) <5 minutes	
6. How frequently do you take pain medicine for these symptoms?			
a) frequently	b) daily	c) occasionally	d) never
7. How frequently do you see a doctor for these symptoms?			
a) frequently	b) monthly	c) rarely	d) never
8. Rank your pain on the following scale:			
0———1———2———3———4———5———6———7———8———9———10			
no pain			worst pain

* The score is calculated by adding: çaé answers = 0 points; çbé answers = 2 points; çcé answers = 4 points; çdé answers = 6 points plus the pain scale added as (10 - x), where x is the number on the pain scale chosen by the patient.

3. Unilateral approach for bilateral decompression;

4. At least 1-year follow-up period.

The mean age was 57 years (SD = 11.77). The indication for surgery was intractable back pain or leg pain with neurogenic claudication unresolved after conservative treatment by medication and physiotherapy. Thirty-nine patients presented with back pain while 12 patients had leg pain. The mean preoperative pain score was 7.6 (range 5-10). All patients had neurogenic claudication with a mean claudication distance of 129.41 meters (range 20-200 meters). The mean tolerable standing time was 15.88 minutes (range 5-45 minutes).

Clinical assessment

Patients with spondylolisthesis from causes other than degenerative or previous lumbar surgery were excluded. Retrospective reviews of hospital charts were conducted to access age, gender, preoperative symptomatology, clinical presentations, VAS, diagnosis, preoperative clinical symptopms were evaluated by NCS (Table 2) and Prolo functional and economic scales (Table 3). Operative records were reviewed for level of surgery. The results of surgery (Neurogenic Claudication Outcome Score and Prolo functional and economic scales) were obtained at 1-year follow-up.

Table 3 Summary of the Prolo Functional and Economic Scales

Score	Criteria
Functional status	
1	total incapacity (worse)
2	moderate-to-severe daily pain (no change)
3	low level of daily pain (improved)
4	occasional or episodic pain
5	no pain
Economic Status	
1	complete invalid (worse)
2	no gainful occupation (including housework or retirement activities)
3	working/active but not at premorbid level
4	working/active at previous level with limitation
5	working/active at previous level without restriction

Excellent outcome score 9-10, Good outcome score 7-8, Fair outcome score 5-6, Poor out score ≤ 4

Radiographic assessment

The interbody fusions were evaluated at 1-year follow-up. The successful fusion was defined by these criteria; absence of radiolucency halo around the screws, presence of bilateral continuous trabecular bone bridge between the fused segments in anteroposterior plain film, and lack of motion in flexion-extension film[1,2,5]. In plain radiograph, the adjacent segment degeneration was also considered by following findings; presence of anterolisthesis or retrolisthesis in adjacent level more than 3 mm and decreased intervertebral disc height more than 3 mm[7].

Statistical assessments

The difference between preoperative and 1-year postoperative symptoms were evaluated in term of VAS, NCS and Prolo functional and economic scales with paired t test, a *P* value of < 0.05 was considered to be significant.

Surgical technique

After general anesthesia, the patient was placed in a prone position on a radiolucent table. The target level was verified by fluoroscopy. The planned incision was marked between target pedicles in line with paravertebral muscles. If more than two levels were operated, we preferred a midline incision in this situation. If paravertebral incision was used, dissection was carried out through lumbodorsal fascia and paravertebral muscle into laminae in the same line with incision. But in midline incision, the lumbodorsal fascia was incised closed to the spinous process, leaving the interspinous ligaments intact; and the paraspinous muscle was elevated from the spinous processes, laminae, and the facet joints. After reach laminae and facet joints, the unilateral hemilaminectomy was then performed at the appropriate levels under microscopy. The ligamentum flavum is completely removed. We tilted the microscope at this time for better visualization of space under spinous processes and contralateral laminae. The spinous process and ligamentum flavum were removed by undercutting technique. At this point, the contralateral nerve roots were clearly seen. Decompression of contralateral nerve roots was performed. Total fecetectomy and discectomy joint were performed for TLIF procedure. The autologous local bone graft or PEEK cage with autologous bone graft was introduced to intervertebral space. The pedicle screws were placed in the standard fashion. The same sequences of dissection to contralateral laminae and facet joints were repeated just only for pedicle screw insertion and posterior bone grafting. The posterior instrumentation was then tightened before closing suture of paraspinal muscle and skin were made[15].

RESULTS

We included 51 cases of patients who underwent transpedicular screws insertion with Unilateral Approach for Bilateral Decompression with TLIF. Thirty-nine patients (76.47%) presented with back pain and 12 patients (23.53%) presented with leg pain. The average preoperative VAS is 7.60 (5-10). The average VAS at 1 year postoperation are 2.56 (0-5), which was significantly reduced from preoperative assessment ($p < 0.05$).

The NCS was used in this study to evaluate neurogenic claudication symptom. At 1- year follow-up, an average NCS was significantly increased from 24.03 to 70.94 ($p < 0.05$). About Prolo functional and economic scales, the average preoperative scores was 4.05 (2-8) and the average postoperative score was 7.47 (5-10). This change reached statistical significance ($p < 0.05$) (Table 4).

Total 57 levels of transforaminal lumbar interbody fusions (TLIF) were performed in this study. At 1-year follow-up, the fusions were successful in all level without complications. Failure of instrumentation and adjacent segment degeneration were not observed.

Table 4 Comparison outcome of VAS, NCS and Prolo score between pre-operation and one year post-operation

	Pre-operation	One year post- operation	*P*
VAS	7.60 (range 5-10)	2.56 (range 0-5)	< 0.05
NCS	24.03 (range 2-44)	70.94 (range 34-96)	< 0.05
Prolo score	4.05 (range 2-8)	7.47 (range 5-10)	< 0.05

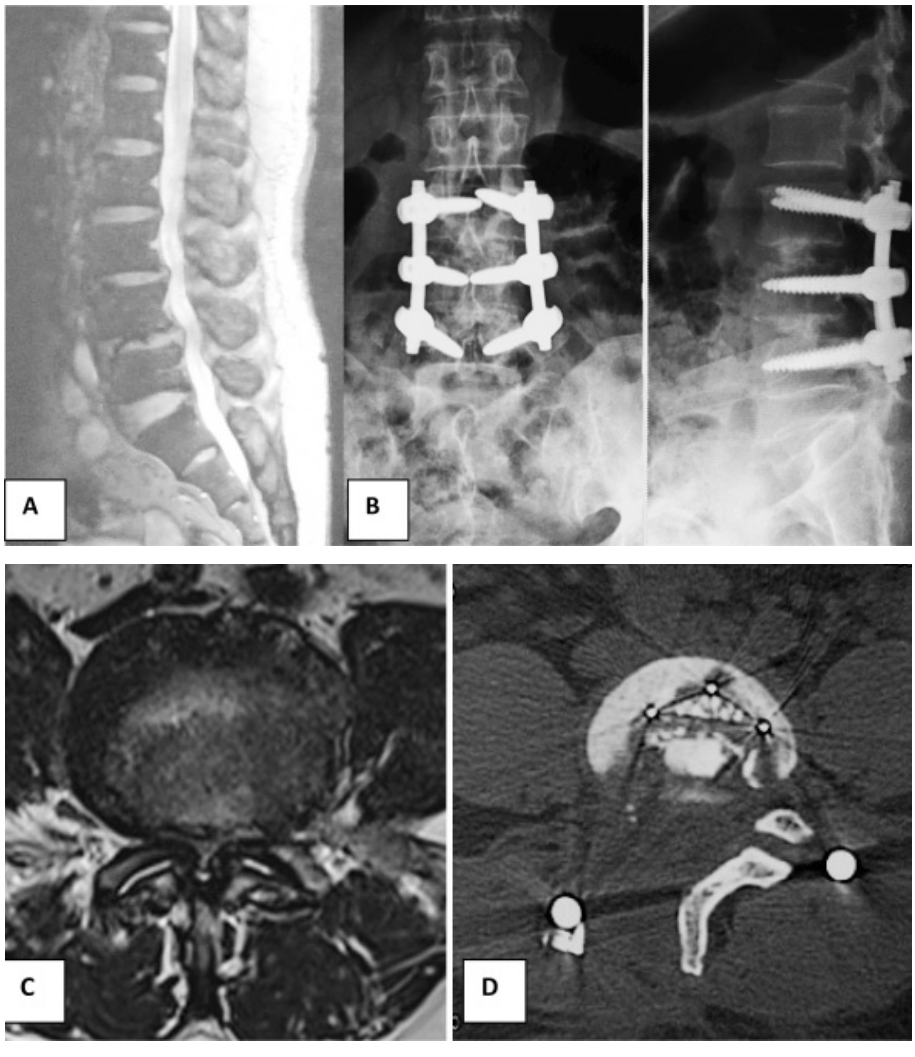

Figure 2 A 56-year-old female patient, Pre-op. MRI : Spondylolisthesis L3-L4, L4-L5 (A), severe spinal canal stenosis on axial view (C), 6 months after unilateral approach for bilateral decompression and fusion at L3-L5 showed no halo around screws and trabecular bone bridge at L4-L5 space on AP plain film (B). Post op Axial CT L4-5 (D)

Discussion

Number of techniques to treat lumbar spinal stenosis have been reported[6,7,8,9]. The procedures share the same purpose which is to decompress the neurological structures. The unilateral approach for bilateral decompression is another technique which theoretically minimizes the surgical insult by limiting the approach only in one side of the spine[6,8,9,13,14]. If degenerative spine problems are complex, most of the patients have a concomitant segmental instability which requires a fusion procedure to provide spinal stability[3,11,15,16]. The authors developed a novel technique called "Unilateral Approach for Bilateral Decompression and Fusion" (UBD & Fusion). Nevertheless, the adequacy and efficacy of this technique have not been investigated. In this paper, the authors studied the efficacy of this technique by comparing preoperative and 1-year postoperative VAS, NCS and Prolo score. Success rate of fusion was also evaluated.

We found significant reduced VAS in patients who were treated with this technique. The VAS reduced from 7.56 (range 5-10) preoperatively, to 2.56 (range 0-5) postoperatively. From NCS, the patients walked longer distance without claudication. The NCS was also significantly higher in postoperative follow-up which indicated adequacy of decompression[9] by this technique. The prolo score was significantly increased which indicated overall functional improvement[2,5].

Intervertebral fusions in this study were all archived in one year after operation. No adjacent segment degeneration, spondylolisthesis and instrument failure were found in our study. The results showed effectiveness of this technique for degenerative spinal stenosis with segmental instability.

With the proposed technique, the unilateral approach in more pronounced compressive symptoms allowed operating surgeon to view all around affected nerve root clearly especially the ventral side which can be compressed by nucleus pulprosus. With an aid of microscope used in this technique, it gave small working window yet adequate for contralateral side decompression[15]. The transpedicular screw fixation and TLIF can be proceeded after decompression in this unilateral approach after unilateral facetectomy and discectomy. The PEEK cage and bone graft can be passed through this small space to the intervertebral space without difficulty[3,12,15].

The TLIF provided long-term stability for unstable spinal segment. Moreover, the interbody fusion give anterior support[18] and restore lumbar lordosis[1,3,15] to spinal column unlike traditional posterolateral fusion. The total facetectomy provided a room for interbody fusion without unevitible excessive nerve root retraction in PLIF[15,17,18]. Thus, TLIF is a preferred method of intervertebral fusion in unilateral approach. An autologous bone graft in intervertebral space and on contralateral lamina enhanced fusion capability in this technique[4,14,16]. Thus, we found fused intervertebral segment in our study. Another benefit of unilateral approach for bilateral decompression and fusion is preserving the posterior elementous complex[7]. Together with posterior instrumentation, they are the key posterior support to prevent adjacent segment degeneration[7] in our study.

The limitation of present study is relatively short-term follow-up of only one year after the index operation. The adjacent segmental instability may not be demonstrated in this duration. The spinal fusion can be properly evaluated by more sophisticate method, such as CT scan, to detect the fusion. Because this technique gives only small working window, the operation requires experienced surgeon who is familiar with distorted degenerative spine.

The result of this proposed technique is promising. It has a potential to be an option for degenerative lumbar spine with nerve root compression and segmental instability. However, the results have to be followed for longer period to evaluate the long-term results. And further study is needed to compare with other decompression and spinal fusion techniques.

Conclusion

The novel technique by unilateral approach for bilateral decompression with fusion is encouraging and safe. This technique gives an adequate bilateral decompression while preserving important posterior stabilizer. The intervertebral fusion by TLIF is also feasible in this small approach with high fusion success rate.

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Original Article

Outcomes of Therapeutic Endoscopic Retrograde Cholangiopancreatography

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Abstract

Objective: **To study the outcomes of therapeutic endoscopic retrograde cholangiopancreatography (ERCP) performed by one endoscopist focusing on results and complications of first biliary cannulation.**

Methods: **Two hundred and fifty nine consecutive therapeutic ERCP procedures were included in the study. Patients were classified into three groups according to sphincterotomy techniques: (1) standard endoscopic sphincterotomy (EST); (2) precut EST; (3) endoscopic balloon dilation (EPBD)/endoscopic large balloon dilation (EPLBD). Characteristics of patients, indications for ERCP, number of instruments used, results and complications were analyzed.**

Results: ERCP for malignant biliary strictures and unintentional pancreatic duct injection were significantly more frequent in the precut EST group compared with the standard EST group. The majority of patients in the EPBD/EPLBD group had cholelithiasis, and required more instrumentation. Of the 259 cases, first biliary cannulation was achieved by using standard sphincterotomy in 204 cases (79%). Immediate precut EST after failed standard cannulation was successful in 46 of 50 cases (92%). The cumulative cannulation success rate was 97% (250 of 259). The precut EST group had the highest complication rate (14%), which was not significantly higher than that in the standard EST group (5%). The EPBD/EPLBD group had the lowest complication rate of 2%.

Conclusion: **Malignant biliary obstruction may cause difficulty in biliary cannulation and may require the use of the precut technique to achieve successful cannulation. Precut EST using both septotomy and needle knife techniques could increase the rate of successful biliary cannulation in difficult cases without significantly increasing the risk of complications. Early precut should be considered when facing with difficult cases to avoid over manipulation of the papilla. EPBD/EPLBD was safe and effective for biliary cannulation and treatment of large CBD stones.**

Keywords: **Cholelithiasis, common bile duct stone, endoscopic balloon dilation, endoscopic retrograde cholangiopancreatography, endoscopic sphincterotomy**

INTRODUCTION

Therapeutic endoscopic retrograde cholangiopancreatography (ERCP) is a very useful procedure for the treatment of biliary tract diseases. The key to success is to achieve deep biliary cannulation which would provide a means for applying other instruments to perform therapeutic procedures. The techniques used for biliary cannulation usually start with the standard endoscopic sphincterotomy (EST) catheter preloaded with guidewire and contrast media. Precutting techniques are normally used after standard

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techniques have failed. Early precut using a needle knife followed by transpancreatic duct precutting called septotomy can also be done. There are many studies showing that both techniques are safe and effective for biliary cannulation. Endoscopic balloon dilation (balloon diameter less than 1 cm: EPBD) or large balloon dilation (balloon diameter greater than 1 cm: EPLBD) are alternative techniques used to replace traditional sphincterotomy in certain situations. EPBD and EPLBD can also be used to dilate the papilla after EST for the treatment of large common bile duct (CBD) stones, and have been shown to be safe and effective.

The present study reviews the outcomes of ERCP performed within the past five years by one endoscopist (K.L.), focusing on patient's characteristics, clinical indications, number of instruments used, results and complications of first biliary cannulation.

Materials and Methods

Between November 2008 and November 2013, 354 ERCPs performed by one endoscopist (K.L.) at the Surgical Department of Nopparat Rajathanee Hospital, Bangkok, Thailand, were reviewed. Ninety five cases were excluded. Among those excluded were pure pancreatic cases, cases where the papilla was not identified, papillary carcinoma, and cases in whom EST was previously done. Two hundred and fifty nine consecutive therapeutic biliary ERCP procedures were included in the study. Patients were classified into three groups according to EST technique.

In all procedures, we began with the use of a standard triple-lumen sphincterotome (Ultratome XL; Boston Scientific, Natrick, USA or Clever Cut; Olympus Medical systems Corp., Tokyo, Japan), preloaded with contrast and a guidewire (0.035" or 0.025" Jackwire; Boston Scientific, Miami, USA or 0.35 angled tip Radifocus guide wire M; Terumo corporation, Shibuya-Ku, Japan) to aid biliary cannulation. When biliary cannulation was achieved, EST was done using the Endocut mode in the ERBE system (120W cut, 15W coagulation, ERBE USA, Atlanta, GA). If this cannulation and EST was successful in a patient, he or she was classified as Group 1, i.e., standard ESTgroup. If the attempted biliary access failed, or if three or more pancreatic duct injections occurred during the attempt, then the pre-cutting technique was performed. If the pancreatic duct was cannulated unintentionally, wire assisted transpancreaticseptotomy technique was used. If the pancreatic duct was not cannulated, pre-cut using triple lumen needle knife (Wilson-Cook Medical, USA) was performed. In very difficult cases, both precutting techniques were used. Patients who underwent these procedures were classified as Group 2, i.e., the precut EST group.

Patients in whom the standard EST technique may increase the risk of post-ERCP bleeding or perforation, or those with large common bile duct stones, after biliary cannulation was achieved using standard techniques, a limited EST was done, followed by EPBD/EPLBD using a balloon catheter (CRE Esophageal/Pyloric maximum diameter 12 mm or 15 mm, length 5 cm, Boston Scientific, USA). The balloon was selected based on the diameter of bile duct and the size of the stones. The balloon would be gradually inflated until the recommended size was reached, and would remain inflated for 30 seconds. In patients with common bile duct stone, the stones would be removed using balloon extraction, baskets, or mechanical lithotripter as needed. Patients requiring these procedures would be classified as Group 3, i.e., the EPBD/EPLBD group.

Sedation for the ERCP procedures consisted of a combination of propofol or fentanyl and midazolam with buscopan as needed for duodenal relaxation. General anesthesia was given depending on patient's conditions and the anesthesiologist's decision. All patients underwent continuous cardiopulmonary monitoring throughout the procedure. The procedures were done in left lateral position, using an Olympus Video Duodenoscope (TJF160R, Olympus Corporation, Tokyo, Japan). After completion of the ERCP, patients were closely observed for post-ERCP complications.

Data for the study was obtained by a review of the medical records. Complications were defined using criteria described by Cotton et al[10]. Differences in categorical variables were tested for statistical significance using Fisher's exact test. *T*-test or rank test was used for quantitative variables. The statistical software package SPSS for Windows version 19 (SPSS Inc, Chicago, IL) was used for statistical analysis. A significance level of 5% was used throughout.

Results

Two hundred and fifty nine consecutive therapeutic procedures were included in the study. There were 105 men and 154 women, with a mean age of 59.1 years. The indications for ERCP were cholelithiasis in 54% of patients, suspected or proven biliary tract malignancy in 22%, and other benign conditions in 24%. Procedures classified as standard EST was performed on 147 patients, those classified as precut procedures was performed on 50 patients, and EPBD/EPLBD was done on 62 patients.

There was no statistically significant difference between the three groups in terms of age, gender, the setting of procedures, the choice of anesthesia, and mean operative time; see Table 1. The precut EST group had a significantly higher frequency of malignant biliary strictures. Also, the frequency of unintentional pancreatic duct injection was significantly higher. The EPBD/EPLBD group had a much higher frequency of cholelithiasis, and a higher mean number of instruments used.

Because the cannulation techniques of both the standard EST and EPBD/EPLBD groups were identical, successful biliary cannulation in either group was considered a success of the standard cannulation technique. Of the 259 cases, first biliary cannulation was successfully performed by the standard technique in 204 cases (142 cases in the standard EST group and 62 cases in the EPBD/EPLBD group) - a success rate of 79%. Immediate precut after failed standard cannulation was successful in 46/50 cases - a success rate of 92%. Total cannulation success rate was thus 250/259 or 97%. Because precut techniques were used after failure of standard techniques, and hence the former was performed on more difficult cases (such as malignant biliary tract stricture), comparing the success rates among the three groups would not be valid.

Overall, complications occurred in 16 of 259 patients, thus the total complication rate was 6%; see Table 2. No major bleeding complications occurred in

Table 1 Contrasting the clinical characteristics among three groups of patients

	All	Standard EST	Precut EST	EPBD/ EPLBD	*p*-value
Total number	259	147	50	62	
Age (mean)	59.1	58.4	56.3	63.1	
Gender					
- Male	105 (41%)	63 (43%)	23 (46%)	19 (31%)	0.179
- Female	154 (59%)	84 (57%)	27 (54%)	43 (69%)	
Setting					
- Elective	249 (96%)	138 (94%)	50 (100%)	61 (98%)	0.110
- Emergency	10 (4%)	9 (6%)	0	1 (2%)	
Anesthesia					
- Intravenous sedation	23 (9%)	11 (7%)	3 (6%)	9 (14%)	0.221
- General anesthesia	236 (91%)	136 (93%)	47 (94%)	53 (86%)	
Unintentional pancreatic duct injection	22 (8%)	9 (6%)	11 (22%)	2 (3%)	< 0.001
Number of instruments used (mean)	1.8	1.7	1.62	2.4	
Operating time (mean)	41.4	30.5	61.8	50.9	
Diagnosis					
- Cholelithiasis	141 (54%)	64 (44%)	20 (40%)	57 (92%)	< 0.001
- Gallstone pancreatitis	15 (6%)	12 (8%)	1 (2%)	2 (3%)	
- Benign stricture of bile duct	8 (3%)	6 (4%)	1 (2%)	1 (2%)	
- Malignant stricture of bile duct	56 (22%)	36 (25%)	19 (38%)	1 (2%)	
- CBD injury (leakage/stricture)	14 (5%)	10 (7%)	4 (8%)	0	
- Normal cholangiogram/passing stone	25 (10%)	19 (13%)	5 (10%)	1 (2%)	
Condition					
- Benign	203 (78%)	111 (76%)	31 (62%)	61 (98%)	< 0.001
- Malignant	56 (22%)	36 (24%)	19 (38%)	1 (2%)	

Table 2 Comparison of complications among the three ERCP groups

	All	Standard EST	Precut EST	EPBD/EPLBD	*p*-value
Major bleeding	0	0	0	0	
Pancreatitis	8 (3%)	4 (3%)	4 (8%)	0	
Perforation	2 (1%)	1 (1%)	1 (2%)	0	
Cholangitis	5 (2%)	3 (2%)	1 (2%)	1 (2%)	
Minor bleeding	1 (1%)	0	1 (2%)	0	
Overall	16 (6%)	8 (5%)	7 (14%)	1 (2%)	0.029*

*Fisher's exact test p-value for the comparison of overall complications

any group. In the standard EST group, the complication rate was 5% (8/147). In this group, there were four cases of pancreatitis, one case of guide wire perforation and three cases of cholangitis. In the precut group, the septotomy technique was used in 36 cases, the needle knife technique was used in 7 cases, and combined techniques used in 7. Of the 36 septotomy cases, 5 had complications (2 with pancreatitis, one cholangitis, one guide wire perforation and one minor bleeding). There were no complications with the needle knife technique, and two cases of pancreatitis occurred in the combined group. The complication rate in the precut EST group was higher than those in both the standard EST and EPBD/EPLBD groups, but was only significantly so when compared with the EPBD/EPLBD technique (7/50 vs 1/62; Fisher's exact test p-value, 0.021). The complication rate in the EPBD/EPLBD group was only 2% (1/62: one case of cholangitis). This group had the lowest complication rate among the three groups (Table 2), but was significant statistically only when compared with the precut group.

DISCUSSION

Precut is an access sphincterotomy that is usually performed when standard cannulation has failed. Many studies support early application of the needle knife during difficult cannulation, which does not seem to increase the risk of pancreatitis, suggesting that pancreatitis develops as a consequence of the attempt to cannulate the papilla, and pancreatic duct injection, and not from precutting[1,2].

Wire assisted transpancreaticseptotomy (ortrans-pancreatic precut sphincterotomy) is a safe and effective alternative to traditional needle knife precutting[6,8]. In expert hands, transpancreatic precut sphincterotomy has a similar rate of pancreatitis compared with conventional biliary sphincterotomy[3]. Other studies reported higher success and lower overall complication rates compared with needle knife precutting[7].

In the present study, the success rate of biliary cannulation using the standard technique was 78% (204 of 259 cases) and the rate using the precut technique was 92% (46 of 50 cases). Thus the overall cannulation success rate was 97% (250 of 259), which was within the range reported in other studies. The lower success rate in the precutting group was likely due the underlying causes of biliary obstruction.

The overall complication rates reported in previous studies were in the range 12% to 18%. In the present study the complication rate was slightly lower, at only 6 %. The incidence of pancreatitis was lower in both the standard EST and EPBD/EPLBD groups compared with the precut group. Both higher overall complication rate and pancreatitis rate in the precut group might be the result of over manipulation of the papilla, leading to an increased risk of complications. The incidence of pancreatitis in the present study was similar to those reported in a previous study, which revealed a late-access pancreatitis rate of 14.9%, as compared with the rate of 2.6% after early precut[1].

EPLBD is an effective and safe maneuver for the removal of large or difficult CBD stones and EPBD should be considered as an alternative to EST for patients in whom EST could not be routinely performed. Prior studies reported that EPLBD was associated with fewer overall complications than EST, and limited EST followed by large balloon dilation is well accepted as an effective method for retrieving large CBD stones, with a low incidence of perforation or bleeding compared with extensive EST. In the present study EPLBD did not increase the risk of adverse events, and had a very low complication rate of 2%.

Conclusions

Malignant biliary obstruction could complicate biliary tract cannulation and more frequently needed precut techniques to achieve success. Both septotomy and needle knife techniques are safe and effective, and could provide additional means of biliary tract cannulation in difficult cases, without significantly increasing the risk of complications. Early precut should be considered when facing difficult cases to avoid over manipulation of the papilla that might increase the risk of complications. EPBD/EPLBD is safe and effective for the treatment of large CBD stones.

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