Background and Aims: The aim of this study is to analyze and compare the early complications and recurrent results of Z-plasty, Limberg flap, and asymmetric modified Limberg flap both demographically and clinically.

Materials and Methods: Between March 2009 and February 2010, a total of 45 patients with pilonidal sinus were enrolled in this study. 10 of 45 patients (22.2%) required Z-plasty; 24 patients (53.3%) had surgery with Limberg flap closure, and 11 patients (24.4%) had asymmetric modified Limberg flap.

Results: A total of 45 patients were included in the study (mean age: 23.36 ±3.4 (range, 20-33) years). When we compared duration of operation and the length of stay in hospital, no statistically significant findings were detected (p=0.595 and p=0.23, respectively). The mean follow-up was 22.4 (range, 18-24) months. Recurrence was not seen in any of the patients.

Conclusions: Our results were similar: the comparison of the three techniques revealed no significant differences regarding early complications and recurrence.

Key words: Pilonidal sinus disease, Z-plasty, Limberg flap, modified Limberg flap.

INTRODUCTION

Pilonidal sinus is a common chronic disease and generally located in the sacrococcygeal region, which is seen particularly in young men and significantly impairs a person’s comfort in daily life with symptoms, such as discharge, swelling, and pain of the coccyx. Although the disease was defined by Herbert Mayo in 1833 for the first time, the name "pilonidal," derived from Latin for hair (pilus) and nest (nidus), was used by Hodge in 1880 for the first time. With regard to etiopathogenesis, although a lot of theories were propounded, at present, it is believed that it is an acquired condition associated with hair insertion to the natal cleft. Although there are numerous methods, including surgical and medical approaches, a method clearly accepted by everyone has still not yet been developed. Nowadays, flap techniques have become more popular owing to quick recovery, short hospitalization, an early return to daily activity, and low complication and recurrence rates. The objective of this study is to analyze and compare results related to the techniques of Z-plasty, Limberg flap, and asymmetric modified Limberg flap for pilonidal sinus treatment.

MATERIAL AND METHODS

In this study, the records of patients (n = 45), who were operated on because of chronic and symptomatic pilonidal sinus disease, and in whom only flap technique was applied, in Sarikamis Military Hospital between March 2009 and February 2010 were retrospectively reviewed. The performance related to just one surgeon was evaluated (BRK). All the patients included in the study were operated on in prone jack-knife position under spinal or local anesthesia. An elliptic, rhomboid, or asymmetric rhomboid excision was performed according to a flap technique by making an incision and deepening it to the post-sacral fascia to include the pilonidal sinus cavity. Subsequently, the prepared fasciocutaneous flaps were transposed Fig. 1. After one piece of multihole and closed suction drain was placed under the flap, the surgical wound was closed in two layers. The drain was removed when drainage decreased to less than 25 cc/day and after having remained in place for at least 2 days. The patients were discharged after their drains were removed. Sutures of the patients were removed 14 days after the operation. Throughout 6 weeks, control when in the clinic at 15-day intervals and follow-up by telephone in terms of recurrence were achieved in 80% of the patients.

RESULTS

A total of 45 male patients (mean age: 23.36±3.4 (range, 20-33) years) were included in the study. The demographic and clinical features of the patients are given in Table I. The most common complaints of the patients were pain (84%), seropurulent discharge (69%), and swelling (60%). The symptomatic period until the surgery was an average of 22.13±17.82 (range, 1-72) months. In 25 pa-
tients (55.6%), an abscess history was present before the operation. In 20 patients (44.4%), no history of previous surgical approach or abscess drainage was present. In 16 patients (35.5%), in whom incision and drainage were carried out because of pilonidal abscess before the operation, the elapsed period until the operation was an average of $2\pm1.19$ (range, 1-5) months. The Limberg flap group included 24 patients (53.3%), the asymmetric modified Limberg flap group comprised 11 patients (24.4%), and the Z-plasty group included 10 patients (22.2%). The operation was carried out in 40 patients (88.9%) under spinal anesthesia and in 5 patients (11.1%) under local anesthesia. No complication as a result of anesthesia was seen in the operated patients. The drain was removed after an average duration of $4.31 \pm 2$ (range, 2-12) days. The mean length of hospital stay was $5.31 \pm 2.02$ (range, 3-13) days. Among the patients, 37 (82%) primarily recovered, and no complication was observed in their postoperative course. With regard to complications, no statistically significant difference was detected among the groups ($p<0.05$). No infection symptoms and findings were encountered in any patient’s follow-up. Overall, in three patients (6.7%), one patient from each group, seroma causing no other complication and only requiring fluid aspiration was identified. In one patient (2.2%) in whom Z-plasty was carried out, excision and suturing for the second time was performed under local anesthesia because of superficial flap ischemia. Wound dehiscence was observed in one patient (2.2%), in whom asymmetric modified Limberg flap was performed on the upper edge of the wound and left for secondary recovery. In one patient (2.2%) in whom a Limberg flap was performed and who complained of swelling on the sixth postoperative day, 40 cc of hemorrhagic fluid was aspirated. During follow-up, no other complication was noted. No recurrence (mean: 22.4 (range, 18-24 months) was encountered in any patient. With regard to the clinical results, no difference in terms of the operation duration, drain removal time, and length of hospital stay was noted between the flap groups ($p=0.595$, $p=0.233$, and $p=0.233$, respectively) (Table II).

In the PubMed database, a literature study was carried out using the keywords of "pilonidal sinus", "Z-plasty", "Dufourmentel flap", "Limberg flap", and "modified Limberg flap". The study was not limited to English publications. All the articles about Z-plasty, Limberg, and modified Limberg flap techniques applied in the surgical treatment of symptomatic sacrococcygeal pilonidal were demographically and clinically examined in detail in terms of the results of early complication and recurrence. Meta-analysis, reviews, letters to the editor, case presentations, case series, and considerable modifications were not included in this study, and we could not find three articles. The results of 57 variations of rhomboid flap repairs studies, 9 AMLF-MLF, and 12 Z-plasty studies, along with our own study, are presented in Table III.

STATISTICAL ANALYSIS

We used analysis of variance (one-way ANOVA), Chi-squared and Kruskall-Wallis test analysis to compare the age, gender, body mass index, duration of the disease, symptoms, history of abscess drainage and recurrence, anesthesia type, duration of operation (min), drain removal time (days), length of hospital stay (days), follow-up (months) of the groups. The data were summarized as mean ± standard deviation. $p<0.05$ was considered to be statistically significant.

DISCUSSION

Although the pathogenesis of pilonidal sinus is controversial, currently, Karydakis’ theory is mostly accepted. According to Karydakis, the three main factors for the hair insertion process are as follows: the presence of loose hairs (the invader), some force facilitating hair insertion into the skin, and the vulnerability of the skin, such as intergluteal sulcus depth. Nowadays, to eliminate this last factor, numerous different surgical procedures have come into prominence. Karydakis, Dufofourmentel, Limberg, asymmetric modified Limberg, Z-plasty, W-plasty, fasciocutaneous V-Y advancement flap, gluteus maximus myocutaneous flap, and rotation flap are some of the procedures aimed to close the skin away from the midline and flatten the natal cleft after excision.

Classic rhomboid or Limberg flap was defined by Alexander A. Limberg through paper models that he personally drew in 1963. The first application of this procedure for pilonidal sinus treatment was reported by Azab et al. in 1984. The Limberg flap technique has become the most appropriate and preferred surgical procedure in recent years because it is simple; requires only short hospitalization time, allowing patients to return to work early; produces minimal discomfort; requires minimum wound care; and has low postoperative complication and recurrence rates. Z-plasty, which is another method for the pilonidal sinus treatment, was first reported by Monro.
and McDermott in 19657. Subsequently, it was reported as the most successful surgical method for pilonidal sinus treatment for the elimination of the intergluteal natal cleft, exhibiting low recurrence rates25-36.

In many studies, no relapse case was encountered; however, in a study by Lamke et al., a 16% recurrence rate was noticed25,26,29,30,33,35. Necrosis on the flap edges, undesired scar formation, the necessity for elaborate surgery, a very wide transposition, and being an over treatment method with numerous complications were noted to be the disadvantages of this method15,29,31,35. By holding the vacuum effect of no flattening of the natal cleft as in the original pilonidal sinus disease, increased anaerobic factors at the midline and continuation of the hairs' tendency to introduce into the subcutaneous fatty tissue were observed. Thus, low rates of early complications, such as maceration, infection, and tissue separation and recurrences, which developed on the lower part of the incision scar close to the midline, were reported. Therefore, the lower part of the Limberg flap incision was lateralized by 1-2.5 cm from the midline as the asymmetric modified Limberg flap procedure. Early complication and recurrence rates in the asymmetric modified Limberg flap procedure were reported to be lower than those in Limberg flap procedure6,39-42.

In this study, the short- and long-term results of Z-plasty, Limberg flap, and asymmetric modified Limberg flap techniques were compared. Early complication and recurrence rates showed no statistical difference between the techniques of Z-plasty and Limberg flap, where the lower edges were observed to come close to the midline, and the asymmetric modified Limberg flap, where this closeness was not observed.

In many studies, closed suction drain was placed under the flap so that complications were avoided by preventing potential space formation as well as seroma and hematoma5-7,14-19,21-24,28,29,33,34,37,39,42-48,79. However, some authors have suggested that the use of drains is unnecessary because hematoma and seroma can be prevented through a meticulous and patient hemostasis. These authors noted that the use of a drain increases the need for painkillers and the risk for infection and prolongs the length of hospitalization3,44-47. Also, in our study, the drains were placed under the flap and kept in place until the flow

### TABLE 1

<table>
<thead>
<tr>
<th>CHARACTERISTICS OF TREATMENT GROUPS</th>
<th>Z-plasty</th>
<th>Limberg flap</th>
<th>Asymmetric Modified Limberg Flap</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients n (%)</td>
<td>10 (22.2)</td>
<td>24 (53.3)</td>
<td>11 (24.4)</td>
<td>45/100</td>
</tr>
<tr>
<td>Age (years)</td>
<td>24.2±4.4</td>
<td>22.9±2.5</td>
<td>23.5±4.2</td>
<td>23.36±3.4 (range, 20-33)</td>
</tr>
<tr>
<td>Gender (M/F)</td>
<td>10/0</td>
<td>24/0</td>
<td>11/0</td>
<td>45/0</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>24.5±1.6</td>
<td>25.8±2.8</td>
<td>25.2±1.2</td>
<td>25.47±2.44 (range, 21.5-33.8)</td>
</tr>
<tr>
<td>Duration of disease (months)</td>
<td>12.5±6.9</td>
<td>21.3±15.5</td>
<td>30.8±24.3</td>
<td>22.13±17.82 (range, 1-72)</td>
</tr>
</tbody>
</table>

### TABLE 2

<table>
<thead>
<tr>
<th>EARLY COMPLICATION AND RECURRENCE AMONG THE TECHNIQUES</th>
<th>Z-plasty</th>
<th>Limberg flap</th>
<th>Asymmetric</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complications n (%)</td>
<td>2(4.4)</td>
<td>2(4.4)</td>
<td>2(4.4)</td>
<td>6(13.3)</td>
</tr>
<tr>
<td>Seroma n (%)</td>
<td>1(2.2)</td>
<td>1(2.2)</td>
<td>1(2.2)</td>
<td>3(6.6)</td>
</tr>
<tr>
<td>Wound infection n (%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Hematoma n (%)</td>
<td>0</td>
<td>1(2.2)</td>
<td>0</td>
<td>1(2.2)</td>
</tr>
<tr>
<td>Necrosis of the tips of the flaps n (%)</td>
<td>1(2.2)</td>
<td>0</td>
<td>0</td>
<td>1(2.2)</td>
</tr>
<tr>
<td>Wound dehiscence n (%)</td>
<td>0</td>
<td>0</td>
<td>1(2.2)</td>
<td>1(2.2)</td>
</tr>
<tr>
<td>Recurrence n (%)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
decreased to less than 20 cc/day. However, after fluid excretion in two patients who required a wide excision, with prolonged drainage of serous fluid that decreased to less than 20 cc/day, seroma was observed following drain removal.

The limitations of this study are the small number of patients and its retrospective nature. However, to our knowledge, this is the first study that compares early complications and recurrent results of three techniques in terms of their respective surgical outcome. This study also highlights the need for large randomized controlled trials comparing Z-plasty, Limberg flap, and asymmetric modified Limberg flap techniques. Such trials would provide more robust evidence in the decision-making process for use of gold standard surgical techniques.

### SUMMARY

POREDJENJE Z-PLASTIKE, LIMBERG-OVOG REŽNJA I ASIMETRIČNOG MODIFIKOVANOG LIMBERG-OVOG REŽNJA KOD PACIJENATA SA PILONIDALNIM SINUSOM


Ključne reči: pilonidalna sinusna oboljenja, Z-plastika, Limberg-ov režanj, modifikovani Limberg-ov režanj

### REFERENCES

Comparison of Z-plasty, Limberg flap and asymmetr. modif.  
Limberg flap techn. for the pilonidal sinus treatment


Note: This study presented as oral presentation at 16th Annual Meeting of European Society of Surgery in Istanbul, Turkey on November 22-24, 2012.