

## Modified Open Mini-Incision Parathyroidectomy for Solitary Parathyroid Adenoma "Cosmetic and Effective"

Soliter Paratiroid Adenomları için Modifiye Açık Mini İnsizyon Paratiroidektomi "Kozmetik ve Etkili"

Oktay Irkorucu<sup>1</sup>, Ümit Turan<sup>2</sup>

<sup>1</sup>University of Sharjah, College of Medicine, Clinical Sciences Department, Sharjah, United Arab Emirates

<sup>2</sup>Adana City Research and Training Hospital, Department of General Surgery, Adana, Turkey

### ABSTRACT

**Objective:** Minimally invasive techniques are becoming more widespread in today's daily endocrine surgery practice. The main aim of this study was to evaluate the applicability of the new modified open minimally invasive parathyroidectomy (MO-MIP) technique in patients with solitary (single) parathyroid adenoma, without the use of auxiliary methods (such as the use of intra-operative parathyroid hormone measurement or gamma probe device).

**Materials and Method:** Only the patients with a concordant ultrasound scan (USS) and MIBI scans (MIBIS) were selected for the study. In addition, 24 PHPT patients who underwent MO-MIP and were operated on by a single surgeon in a single centre were evaluated. Records of patients were reviewed especially for pre-operative symptoms, pre-operative localisation imaging, operation findings, pre- and post-operative biochemical findings, and any observed complications.

**Results:** Right-sided adenomas (15/24) were more common than left-sided lesions (9/24). The mean pre-operative parathyroid hormone (PTH) level was 269.2 pmol/l, whereas the mean post-operative (24 h) PTH level was 22.2 pmol/l ( $p = 0.0001$ ). The mean pre-operative serum calcium level was 11.5 mmol/l, and the mean post-operative (24 h) calcium level was 8.9 mmol/l ( $p = 0.001$ ). The short-term follow-up cure rate was 100%.

**Conclusion:** MO-MOP, performed by an experienced surgeon, can be used effectively and safely, with better aesthetic results, in the treatment of solitary parathyroid adenoma.

**Keywords:** Parathyroid, Hypercalcemia, Parathyroidectomy, Calcium

**Received:** 04.25.2020

**Accepted:** 03.14.2021

### ÖZET

**Amaç:** Bugün, minimal invaziv teknikler giderek yaygınlaşmaktadır. Bu çalışmanın amacı, soliter paratiroid adenomu olan hastalarda intraoperatif paratiroid hormon monitörizasyonu veya gama probu kullanılmadan yapılan yeni modifiye açık minimal invaziv paratiroidektomi (MO-MIP) tekniğinin fizibilitesinin, değerlendirilmesidir.

**Gereç ve Yöntem:** Sadece eş zamanlı ultrasonografi (USS) ve MIBI taramaları (MIBIS) olan hastalar çalışma için seçildi. Bu çalışmaya, MO-MIP uygulanmış ve tek bir cerrah tarafından ameliyat edilen 24 PHPT hastası dahil edildi. Hasta kayıtları özellikle preoperatif semptomlar, preoperatif lokalizasyon görüntüleme, operasyon bulguları, operasyon öncesi ve sonrası biyokimyasal bulgular ve karşılaşılan komplikasyonlar açısından gözden geçirildi.

**Bulgular:** Sağ taraflı adenomlar (15/24), sol taraflı lezyonlardan (9/24) daha sıkı. Preoperatif ortalama paratiroid hormonu (PTH) düzeyi 269.2 pmol / l iken, ilk 24 saatteki ortalama postoperatif PTH düzeyi 22.2 pmol/l idi ( $p = 0.0001$ ). Preoperatif ortalama serum kalsiyum seviyesi 11.5 mmol/l idi ve ilk 24 saatte ortalama post-operatif kalsiyum seviyesi 8.9 mmol/l idi ( $p = 0.001$ ). Kısa süreli takip için kür oranı da %100 idi.

**Sonuç:** Deneyimli bir cerrahın elindeki MO-MIP, soliter paratiroid adenomunun tedavisinde daha estetik sonuçlar veren etkili ve güvenli bir teknik olabilir.

**Anahtar Sözcükler:** Paratiroid, Hiperkalsemi, Paratiroidektomi, Kalsiyum

**Geliş Tarihi:** 25.04.2020

**Kabul Tarihi:** 14.03.2021

**ORCID IDs:** O.I.0000-0001-8707-5301, Ü.T.0000-0002-7337-325X

**Address for Correspondence / Yazışma Adresi:** Oktay Irkorucu, MD Mahfesiğmaz Mah. 79043 Sok. Hacı Omay Apt. Kat:2 No:2 Çukurova, Adana, Turkey E-mail: oktaytip@yahoo.com

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doi: <http://dx.doi.org/10.12996/gmj.2022.07>

## INTRODUCTION

Today, surgery is the main treatment for primary hyperparathyroidism (PHPT), and it is well known that PHPT is the result of solitary (single) adenoma in 80–85% of patients (1–6). Traditionally, most general surgeons prefer bilateral cervical investigation to remove the enlarged solitary parathyroid adenoma. On the other hand, advances in pre-operative localisation techniques such as MIBIS and increasing patient demand for more minor invasive procedures and minimally invasive surgical techniques to the parathyroid glands attract the attention of aspiring surgeons. As a result, they have been applied very successfully in the last 20 years (2–4). Generally, minimally invasive parathyroidectomy (MIP) is defined as any focused or targeted modern surgical approach to remove solitary parathyroid adenoma and treat the patient (2–5). However, it encompasses several surgical techniques including open, endoscopic and robotic approaches that use acceptable "mini or small incisions" (2–6).

In this study, we used a modified mini-incision surgery technique for minimally invasive surgery. We carefully examined the demographic features, pre-operative symptoms and findings, pre-operative examinations (including blood tests and radiological examinations), intra-operative findings, histology, and post-operative follow-up. The main aim of this study was to determine the success rates and evaluate the feasibility of modified open minimally invasive parathyroidectomy (MO-MIP) in patients with solitary parathyroid adenoma, without the use of auxiliary methods such as intra-operative parathyroid hormone (IOP) measurement or gamma probe device usage.

## MATERIALS and METHODS

*Inclusion criteria*

This study included 24 of 64 patients with PHPT, operated on by a single surgeon. The diagnosis of primary hyperparathyroidism was based on the presence of hypercalcemia and high serum parathyroid hormone level in patients. The patients included in the study met criteria set by the NIH consensus and were symptomatic. The localisation of the pathological parathyroid gland(s) and the condition of the thyroid tissue in all patients were carefully evaluated pre-operatively, with both US and MIBI imaging performed on the neck. This study included only the patients who underwent an operation with pre-operative imaging suggestive of solitary adenoma (with concordant USS and MIBIS). Concordance was considered positive when both the side and site (upper/lower) matched.

*Exclusion criteria*

Patients with suspected parathyroid hyperplasia or multiple endocrine neoplasm syndrome were excluded from the study because such patients require bilateral neck exploration. In addition, patients with concomitant thyroid disease and recurrent/permanent hyperparathyroidism were also excluded.

*Study design*

Patient records were used to identify sex and age. The records were also reviewed especially for pre-operative symptoms, pre-operative localisation imaging, operation findings, pre- and post-operative biochemical findings, and any observed complications. In all patients, initial diagnosis of PHPT was confirmed by an endocrinologist. Following diagnosis, all MO-MIP was performed electively by one experienced surgeon, under general anaesthesia and without the use of IOPH monitoring or gamma probe device. All patients undergoing MO-MIP were given detailed information before surgery and were informed that bilateral neck exploration would be initiated if necessary. Patients were asked by the surgeon about their satisfaction with the surgery at their follow-up appointment.

*Follow up*

Patients were discharged after PTH samples and serum calcium samples were collected at the 24th post-operative hour. Consistent with the literature, permanent hyperparathyroidism was defined as the state of hypercalcemia encountered in the first 6 months after the operation, in the post-operative follow-up period. Recurrent hyperparathyroidism was defined as the return of high calcium and PTH levels after a 6-month normocalcemia period has passed. Patients were discharged with a 1-week course of paracetamol 500 mg three times daily, with suture removal after 1 week.

Outpatient consultation was arranged at post-operative month 1 firstly, and post-operative month 3 secondly, with blood PTH, calcium and phosphate measurement. The final pathology reports were also reviewed.

*Surgical procedure*

The operations were performed in a standardised manner. Patients were placed in the semi-Fowler neck extension position with a roll underneath the shoulders and a mild neck extension (6). Our technique can be described as a modification of the classical minimally invasive parathyroidectomy technique. In this technique, we use a lateral oblique access incision to use central access. Additionally, we performed a subcutaneous dissection to create an operating space that gives the skin excellent mobility. The size of the skin incision was made as small as possible, usually according to the size of the adenoma (usually no more than 2–2.5 cm). The incision was made just above the suspected area of the adenoma, adhering to the projection of previously performed imaging methods. A naturally oblique mini-incision (not transverse) was performed parallel to the medial border of the sternomastoid muscle. This type of incision can be enlarged up or down when necessary and allows for easy conversion to the traditional cervical collar incision. The subcutaneous area was dissected by electrocautery and finger dissection over the strap muscles to create an accurate working space.

Additionally, this dissection allows for reaching the midline quickly. The strap muscles are then divided in the midline longitudinally for no more than 3–3.5 cm. In other words, the technique uses a "lateral skin incision and midline approach" to the parathyroid adenoma. One retractor can be used to gently retract the strap muscle laterally on the side of the suspected adenoma. When necessary, the thyro-tracheal groove can be exposed after cutting the middle thyroid vein. The thyroid lobe can be mobilised if needed and can be retracted medially with a Babcock clamp. Once the adenoma is sighted, it is imperative to dissect without disrupting the capsule, by using gentle blunt dissection. The enlarged parathyroid gland is excised carefully without causing bleeding, while care is taken not to injure the recurrent laryngeal nerve. Intra-operative frozen section was performed to ensure that parathyroid tissue had been removed in all cases, with a median turnaround time of 15 min. On confirmation, the muscles and skin were closed with a non-absorbable suture. A drain was not used in any procedure; however, to enable early detection of post-operative bleeding (Figure 1), we recommend against closing the midline tightly. Intra-operative adjuncts such as a gamma probe and IOPH measurements were not used.



**Figure 1:** The appearance of the incision in the post-operative follow-up period

*Ethics*

This study was approved by the ethics committee of SBU, Adana Numune Research and Education Hospital (ANEAH. EK. 2016/26). It was carried out applying ethical rules in the Helsinki Declaration.

*Statistical Analysis*

Statistical analysis was performed using the SPSS 20 statistical software package. Data were analysed with Mann–Whitney U and Wilcoxon tests. Statistical significance was defined as a p-value < 0.05.

## RESULTS

*Patients and Symptoms*

A total of 24 patients who underwent MO-MIP were identified and included in this study. While the median age of the patients was 54.34, the youngest age was 29, and the oldest was 80 (F / M = 23/1). The mean operation waiting time was 6 weeks. In addition, 4 of 24 (16.66%) patients presented with renal calculi, 18 of 24 (75%) with musculoskeletal symptoms such as osteoporosis, myalgia and bone pain, and 2 of 24 (8.34%) with psychological symptoms or abdominal pain.

*Anatomical Distribution of Adenomas*

The study found 23 of 24 (95.83%) adenomas in the lower pole positions. Right-sided adenomas (15/24) were slightly more common than left-sided lesions (9/24); of those, adenomas were found in positions other than the lower pole (1/24).

*Biochemical tests*

The mean pre-operative PTH level was 269.2 pmol/l, whereas the mean 24 h post-operative PTH level was 22.2 pmol/l. At the 1st post-operative month, it was 43.3 pmol/l. At the 3rd post-operative month, the mean PTH level was 42.0 pmol/l. These post-operative results were within normal range. The study found a statistically significant difference between pre-operative and post-operative serum calcium levels ( $p = 0.0001$ ).

The mean pre-operative serum calcium level was 11.5 mmol/l, and the mean 24 h post-operative calcium level was 8.9 mmol/l. The mean calcium level at post-operative month 1 was 9.2 mmol/l, whereas the mean serum calcium level at post-operative month 3 was 9.3 mmol/l. Normocalcemia was achieved in 100% of patients ( $p = 0.0001$ ) (Table 1). These patients were carefully monitored for 6 months; no increases in serum calcium levels were observed.

**Table 1:** Comparison of pre-operative and post-operative biochemical parameters.

	Type of Surgery						Wilcoxon test					
	Modified Open – Minimally Invasive						Pre-op–Post-op1		Pre-op–Post-op2		Pre-op–Post-op3	
	n	Mean	Median	Minimum	Maximum	sd	z	p	z	p	z	p
<b>Pre-op Ca</b>	24	11,5	11,3	10,5	13,9	0,8						
Postop Ca 1	24	8,9	9,0	7,5	10,6	0,7	-4,2	0,0001	-4,3	0,0001	-4,1	0,0001
Post-op Ca 2	24	9,2	9,3	8,0	9,9	0,6						
Post-op Ca 3	22	9,3	9,3	8,2	10,1	0,5						
<b>Pre-op P</b>	24	2,8	2,9	1,9	5,8	0,8						
Post-op P 1	24	3,1	3,0	2,3	4,1	0,5	-2,1	0,044	-3,2	0,001	-3,4	0,001
Post-op P 2	24	3,4	3,2	2,3	5,0	0,6						
Post-op P 3	22	3,3	3,3	2,0	4,1	0,6						
<b>Pre-op PTH</b>	24	269,2	174,6	92,6	2347,0	447,9						
Post-op PTH 1	24	98,7	22,2	4,2	1818,0	366,5	-4,3	0,0001	-4,3	0,0001	-4,1	0,0001
Post-op PTH 2	24	106,7	43,3	18,0	1559,0	309,7						
Post-op PTH 3	22	74,9	42,0	15,0	782,0	158,7						

PTH: parathyroid hormone; Ca: calcium; P: phosphate; n: number of patients; Post-op 1: 24 h post-operative; Post-op 2: at 1st month; Post-op 3: at 3rd month.  $p < 0.05$  is considered statistically significant

*Post-operative Follow-Up*

MO-MIP was performed in 24 patients successfully with no conversion to neck exploration. In all patients, the excised material was sent for frozen examination and reported by the pathology department: 100% of the samples were parathyroid tissue. Seventy-five per cent (18/24) of patients treated with MO-MIP were discharged and returned home on the 1st post-operative day. On the 2nd post-operative day, the remaining 25 per cent (6/24) of patients were discharged and returned home. All patient cases were followed up within 6 months. In 24 (100%) patients, US and MIBIS correctly identified the adenoma later found in surgery.

*Post-operative Complications*

Of the PHP patients included in the study, 91.66 per cent were subjectively satisfied with the results of the MO-MIP surgical technique. In this study, only two patients developed post-operative hypocalcemia and needed intravenous calcium replacement. There was no reported voice disturbance and no other significant complications such as significant vessel injury or hematoma.

## DISCUSSION

It is well known that 85 per cent of patients with PHPT harbour a single adenoma and are generally cured by excision of the pathological gland (7). The indications for MO-MIP are the same as those for traditional cervical exploration. However, if the pre-operative localisation of the parathyroid adenoma has been performed successfully, most of the authors prefer minimally invasive techniques (8). The commonly performed localisation studies are the 99Tc sestamibi scan and cervical ultrasound (9). A combination of MIBIS and a radiological investigation such as USS has been described as equivalent to an open conventional bilateral exploration of the neck for localising the parathyroid lesion (10,11). In the present study, all cases had pre-operative concordant USS and MIBIS: these selected patients underwent MO-MIP. The operation success rate was 100%. We should emphasise that MO-MIP should be proposed only for patients with sporadic hyperparathyroidism in whom concordant pre-operative imaging studies have clearly localised a single adenoma.

MIP is a general term that includes mini-incision focusing and targeted procedures under local or general anaesthesia and video-assisted endoscopic parathyroidectomy, with or without intra-operative gamma probe or IOPTHA (12).

In the literature, some authors have argued that in the presence of compatible pre-operative localisation studies, routine IOPTH measurement, which is considered an aid to surgery while performing focused and targeted parathyroidectomy for many PHPT cases, can be skipped safely and smoothly (13). Additionally, traditional routine perioperative or intra-operative use of gamma probe device or IOPTHA, to determine resection adequacy and accuracy, has never increased the success rate of treating single-gland PHPT disease when the disease is sestamibi and ultrasound compatible, even in high-volume endocrine surgery centres (12,14). In this study, all operations were performed without an intra-operative gamma probe device or IOPTHA. An intra-operative frozen section was performed to ensure parathyroid tissue had been removed. In all cases, the post-operative serum PTH and Ca results were lower than the upper limit of normal ( $p = 0.0001$ ). Therefore, according to our results, MO-MIP may be advocated as an alternative to bilateral neck exploration, owing to its reduced morbidity and increased success rate.

MO-MIP, described here, is a semi-novel hybrid operation because, in this technique, generally, we use a mini-incision not more than 2.5 cm. The differences between MO-MIP and MIP are as follows: firstly, unlike classical MIP, we use a lateral oblique access incision to use central access. Additionally, we perform a subcutaneous dissection to create a space that gives the skin excellent mobility. Secondly, although we use a lateral incision, we reach parathyroid adenoma by midline beneath the skin. These minor modifications provide a good access route to parathyroid adenoma. A relaxed skin and a "lateral incision-midline approach" permit thorough exploration of the neck.

Furthermore, MO-MIP is an anatomical approach that eliminates the need for muscle cuts and vessel ligation. Additionally, a transverse oblique incision is a good option for a good cosmesis, and this kind of oblique incision allows for enlarging, when necessary, as well as easy conversion to the classical cervical collar incision. In the technique, the surgeon operates with direct vision; there is no need to use a scope, robot, and auxiliary materials. Therefore, MO-MIP may be a practical, cosmetic, and feasible technique in selected patients. Our technique embodies a fundamental principle of endocrine surgery: to keep things as simple as possible.

In this decade, patient expectations of parathyroid surgery have changed, and patient interest in minimally invasive techniques has increased dramatically (3–6). Our low complication and high success rates reflect the safety of MO-MIP. In the present study, only two patients presented with post-operative hypocalcaemia: this hypocalcaemia most likely reflected "hungry bone" syndrome. These two patients recovered well.

MO-MIP is minimal due to a mini-incision and involves minimal, gentle, and bloodless tissue dissection and better cosmesis with a high success rate. The technique's only significant disadvantage may be the risk of missing possible multiglandular disease or a second adenoma (neither occurred in this study) (12, 15–21). The key to performing a successful MO-MIP is in the pre-operative workup. Therefore, we recommend MO-MIP in well-localised solitary adenomas with concomitant USS and MIBIS.

In conclusion, the primary limitations of this study are its single-centre design, relatively small sample size, and short follow-up time. Nonetheless, our study showed that with careful patient selection and prompt use of pre-operative imaging modalities such as USS and MIBIS, in the hands of an experienced surgeon, MO-MIP might be an effective and safe surgical technique for the treatment of solitary parathyroid adenoma, with better aesthetic results.

#### Conflict of interest:

The authors declared no conflict of interest.

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