A New Needle Holder Facilitating Palm Grip Suturing

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Key Words
Operation technique · Surgery · Suture material · Suturing · Wound healing

Abstract
Purpose: The finger grip and the palm grip are the most common needle holder grips for hand suturing in surgery. The major advantages of the palm grip are an increased versatility and the possibility to apply controlled force. However, there is a risk for a potential loss of precision and uncontrolled movement of the needle when disengaging the ratchet mechanism of the palmed instrument. The purpose of this study was to develop a new needle holder, referred to as the Frimand needle holder (FNH), and evaluate surgeons’ perception of it. It was designed to overcome the above-mentioned disadvantages, hence facilitating palm and finger grip suturing. Moreover, we evaluated suture precision and attitudes related to the use of the finger grip and the palm grip. Methods: Thirty-two surgeons performed sutures utilizing both the palm grip and the finger grip on postmortem porcine skin and small bowels, comparing the FNH to a standard Crile-Wood needle holder (CWNH). The participants assessed the FNH on an evaluation form. Precision was determined by letting the surgeons perform 20 sutures utilizing the finger grip and the palm grip on a polyurethane pad with premarked insert and exit sites. The distance between the designated exit site and the real exit site defined precision and was measured with a digital sliding dimension scale. Results: We found that 28 (88%) of the 32 surgeons use the palm grip to some extent, and 31 surgeons (97%) experienced an advantage when suturing with the FNH using the palm grip. Twenty-four (75%) of the 32 surgeons would prefer to suture with the FNH instead of the CWNH. There
was no significant difference in precision between the finger grip and the palm grip. **Conclusion:** This study presents a new needle holder facilitating palm grip suturing. A majority of the participants preferred the new FNH over the standard CWNH for hand suturing.

### Introduction

There are numerous types of needle holders, and the majority are based on the Hegar needle holder, which is largely preferred by surgeons. The handling and choice of needle holder is a matter of personal preference and the properties of the intended procedure [1]. Investigations dealing with grip preferences and surgical techniques have scarcely appeared in the literature [2]. Two common needle holder grips are the finger grip and the palm grip. These two grips have previously been assessed regarding suture precision, with the conclusion that the palm grip is more accurate, although equivalent accuracy utilizing the finger grip can be gained by wavering [3]. However, suture wavering is assumed to be potentially tissue damaging and should thus be avoided [3]. The finger grip allows controlled needle manipulation and avoidance of inadvertent motions during the disengagement of the ratchet mechanism when releasing the needle [4]. The major advantages of the palm grip are an increased versatility and the possibility to apply controlled force [4].

When utilizing the palm grip, surgeons have to start by locking the needle using the finger grip and subsequently switch to the palm grip in order to perform the suture. To release the needle, which is now inserted in the designated tissue, the surgeon can either return to the finger grip or open the ratchet mechanism by using the thenar eminence. The latter requires dedicated practice and skillfulness and is often regarded as unstable and insecure, rendering the surgeon with the first option. The major disadvantages of the palm grip are a potential loss of precision when one is disengaging the ratchet mechanism and uncontrolled movement of the needle when it is half through and still imbedded in the tissue [4].

The purpose of this paper was to develop a versatile needle holder facilitating suturing in both the finger grip and the palm grip, hence circumventing the need for grip transitions and insecure release maneuvers when suturing in the palm grip. Moreover, we evaluated surgeons’ perception of this novel device, referred to as the Frimand needle holder (FNH) as well as suture precision and attitudes related to the use of the finger grip and the palm grip.

### Materials and Methods

All surgeons at the Department of Surgery, Skåne University Hospital, Malmö, Sweden, were invited to participate in this study between July 2013 and February 2014. The total number of possible candidates was 45. This study enrolled 32 of them (21 men and 11 women): 20 senior surgeons (defined as having more than 2 years’ experience since the completion of surgical specialization) and 12 junior surgeons (defined as residents or specialists with less than 2 years’ experience since the completion of surgical specialization).

Two pilot tests were conducted prior to the actual tryouts. The tests were executed with a 16-cm FNH (fig. 1) and a 16-cm Crile-Wood needle holder (CWNH) – a common Hegar-styled needle holder (HSNH) – (fig. 2). The latter was adopted as a reference, since it matches the FNH in aspects of size, jaws and shanks. Both adopted needle holders and all additional instruments (forceps, scissors, knives) were manufactured by Stille AB (Solna, Sweden). The FNH differs from the HSNH in 3 key features: (1) the shanks are slightly bent, connecting to the outer part of the rings, which improves instrument stability when handling the needle holder in the palm grip; (2) the spring is inserted in one of the shanks close to the box lock, producing a slight outward pressure, and (3) the ratchet mechanism is rotatable, which allows the needle holder to open after passing the last ratchet (fig. 1). These features enable the surgeon to unlock the needle holder when utilizing the palm grip (fig. 3) by simply compressing the opposed shanks. The rotatable ratchet mechanism disen-
**Fig. 1.** FNH. There are three key differences from the HSNH: 1. the shanks are connected to the outer part of the rings, contributing to support when handling the instrument in the palm grip; 2. the spring is inserted in one of the shanks, producing a slight outward pressure, and 3. the ratchet mechanism can be rotated, which allows the needle holder to open the instrument after passing the last ratchet. These features enable the surgeon to disengage the ratchet mechanism and open the needle holder in the palm grip by compressing the opposed shanks.

**Fig. 2.** CWNH. A common and delicate HSNH.

**Fig. 3.** Palm grip, CWNH. The needle holder is grasped in the palm of the hand without inserting any fingers into the rings. The major advantages of this grip are an increased versatility and the possibility to apply controlled force.
gages after passing the last ratchet, and the spring opposes the shanks, hence opening the needle holder. Alternatively, the FNH can be detached in the palm grip, in the same manner as the HSNH, with the thenar eminence. The spring inserted in the FNH is thought to facilitate this procedure, since the surgeon only has to disengage the ratchet mechanism by applying light pressure with the thenar eminence as opposed to applying pressure and abducting, as is necessary with the HSNH. The FNH is operated in the exact same way as the HSNH when suturing in the finger grip (fig. 4).

**Instrument Preference**

To assess instrument preference, the surgeons sutured postmortem porcine skin and small bowels (obtained from a slaughterhouse) using 60 cm of 3.0 monofilament (Biosyn; Synture, Norwalk, Conn., USA) for the skin sutures and 90 cm of 4.0 monofilament (Surgipro II; Synture), equipped with double needles for the small bowel sutures.

The porcine skin was prepared with 25-cm-long and 1-cm-wide cuts. The porcine small bowel was cut prior to the test, each part fixated with forceps. The surgeons were instructed to make a minimum of 15 sutures using each of the two grips, repeated with both needle holders, on porcine skin to evaluate the FNH in comparison with the CWNH (fig. 5). The surgeons were encouraged to try the different options of palm grip release, hence disengaging the ratchet mechanism using the thenar eminence with both instruments: compressing the opposed shanks with the FNH and changing to the finger grip with the CWNH. The surgeons were then asked to suture an end-to-end anastomosis on the porcine small bowel tissue, utilizing the palm grip (fig. 6). Half of the anastomosis was sutured with the FNH, the other half with the CWNH. Both sides were sutured in the craniocaudal direction. The order of use was alternated.

Fig. 4. Finger grip, CWNH. The first and fourth fingers are inserted into the rings, and the index finger is put around the legs. The finger grip allows controlled needle manipulation and the avoidance of inadvertent motions during the disengagement of the ratchet mechanism when releasing the needle.

Fig. 5. Sutures performed on porcine skin, prepared with 25-cm-long and 1-cm-wide cuts. The surgeons were instructed to suture a minimum of 15 sutures in both the palm grip and the finger grip, repeated with both needle holders, on porcine skin to evaluate the FNH in comparison with the CWNH.
between the two needle holders; thus half of the surgeons started with the FNH, the other half with the CWNH.

Prior to the test, the surgeons were presented an evaluation form (tables 1, 2), which was reviewed question by question. After the test, the surgeons filled out the form without the involvement of the tester, unless they had any questions.

**Precision**

Precision was defined as the distance between a premarked designated exit site and the actual exit site when suturing on a polyurethane pad. The polyurethane pad (wound closure pad light; AB Waldemar Larsson, Sollentuna, Sweden) was marked with insert and exit sites at an 8.5-mm distance, since the 1/2-circle cutting needle with a diameter of 12 mm, as employed, produces a theoretic suture stride with an 8.5-mm suture span on a 90-degree rotation (the theoretic suture stride is equal to the base of an isosceles right-angled triangle whose equilateral side is equal to the radius of the needle curvature \([\frac{1}{2} \times 12] / 2 \text{ mm} = 8.49 \text{ mm}\)). The insert sites were connected with a line, the exit sites were marked by 0.7-mm perforations.

Each surgeon performed 10 sutures utilizing the finger grip and 10 sutures utilizing the palm grip, alternating grips every other suture. The surgeons were not allowed to waver, since waverering is regarded as potentially tissue damaging [3]. After suture placement, the needle was left in the polyurethane pad and the

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**Table 1. Evaluation form for the FNH (n = 32)**

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Which is your habitual grip?</td>
<td>Finger grip</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Palm grip</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Both</td>
<td>11</td>
</tr>
<tr>
<td>If the finger grip is your habitual grip, do you ever use the palm grip?</td>
<td>Yes, seldom</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Yes, sometimes</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Yes, often</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>4</td>
</tr>
<tr>
<td>Is it an advantage be able to lock and/or release the needle in the palm grip, without having to change to the finger grip?</td>
<td>Yes</td>
<td>31*</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>1</td>
</tr>
<tr>
<td>If yes, please grade the impact of the FNH on this maneuver:</td>
<td>No impact</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Small impact</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Great impact</td>
<td>24*</td>
</tr>
</tbody>
</table>

* Significant majority, \(p < 0.001\).
distance between the designated exit site and the real exit site was measured with a digital sliding dimension scale (digital caliper 150 mm; Velleman, Gavere, Belgium), measuring the furthest distance from the needle to the center of the perforation. The needle radius (0.23 mm) was subtracted from the measurements, since the needle diameter was included in the measurements.

The aim was to detect any differences in accuracy between the palm grip and the finger grip. The accuracy was assumed to be independent of the choice of needle holder; hence, the FNH was employed for all sutures.

**Statistics**

We assumed that there was no difference in attitude towards the FNH and CWNH regarding preference. Consequently, the binomial distribution using parameter 1/2 for the expected probability of the surgeon’s preference for the FNH was utilized for significance testing when comparing these two alternative needle holders. The statistical computations were performed using the binomial distribution function facility of Microsoft Excel 2010.

**Ethics**

The study was conducted after applying for ethics approval by the Ethics Council, Lund University (application No. 2013/389).

**Results**

**Instrument Preference**

Thirty (94%) of the 32 surgeons reported that they change to the finger grip when disengaging the ratchet mechanism in the palm grip with the CWNH; the remaining 2 surgeons used the thenar eminence for the release in the palm grip. The latter 2 surgeons and an additional 3 surgeons (16%) chose to disengage the FNH with the thenar eminence when suturing.
in the palm grip; 27 surgeons (84%) chose to disengage the FNH in the palm grip by pressing the opposed shanks together.

We found that 28 (88%) of the 32 surgeons use the palm grip, divided into 15 surgeons (54%) stating that their habitual grip was either the palm grip or both the palm grip and the finger grip and 13 surgeons (46%) stating that they use the palm grip seldom, sometimes or often (table 1).

Thirty-one surgeons (97%) think that it is an advantage to be able to lock and/or release the needle in the palm grip without having to change to the finger grip, and 30 (97%) of these stated that the FNH impacts this maneuver (table 1). Interestingly, 10 surgeons (31%) stated that they acknowledged an advantage and 6 surgeons (19%) stated that they experienced a disadvantage when suturing with the FNH utilizing the finger grip (table 2). The remaining 16 surgeons thought that the FNH was equal to the CWNH when suturing in the finger grip (table 2). Moreover, 31 surgeons (97%) reported that they experienced an advantage when suturing in the palm grip with the FNH (table 2). The only surgeon who saw no advantage of the FNH when suturing in the palm grip (table 2) was also the only one who stated that there was no advantage in being able to lock and/or release the needle in the palm grip (table 1).

Asked whether they would prefer to suture with the FNH, 24 surgeons (75%) answered they preferred the FNH, 3 surgeons (9%) answered they preferred the standard needle holder, and 5 surgeons (16%) answered they were indifferent (table 2). Twenty-four surgeons (75%) think that the risk of tissue traction might be reduced employing the FNH in comparison with the standard needle holder (table 2). Twenty-one (75%) of the 28 surgeons who alternate between the palm grip and the finger grip stated that they would use the palm grip more frequently if employing the FNH (table 2).

There was a slight difference in attitude towards the FNH between the junior and the senior surgeons, considering that 9 (90%) out of 10 junior surgeons stated that they preferred to suture with the FNH, in contrast to 15 (68%) out of 22 senior surgeons who preferred to suture with the FNH. The difference was, however, not significant.

**Precision**

Eighteen (56%) of the 32 surgeons sutured more precisely in the palm grip in comparison with the finger grip. Interestingly, 4 of the 8 surgeons who stated that they never or seldom use the palm grip were actually more accurate using the palm grip. Furthermore, 10 of the 17 surgeons who habitually suture in the finger grip were more precise when suturing in the palm grip. Three of the 4 surgeons who listed their habitual grip as the palm grip placed their sutures with higher precision in the palm grip. Six of the 11 surgeons who listed their habitual grip as both the palm grip and the finger grip were more precise using the palm grip. There was no significant difference between the median distance values using the finger grip (0.67 mm, range 0.21–1.66) and those using the palm grip (0.65 mm, range 0.09–1.46). The median distance values of the junior surgeons (finger grip: 0.63 mm, range 0.21–1.36; palm grip: 0.66 mm, range 0.16–1.14) were slightly lower than the median distance values of the senior surgeons (finger grip: 0.71 mm, range 0.43–1.66; palm grip: 0.81 mm, range 0.09–1.46).

**Discussion**

The current paper presents a new needle holder, the FNH, thought to facilitate palm grip suturing. Furthermore, we investigated whether this novel device is an eligible alternative to HSNH as well as to evaluate precision and attitudes related to the different needle holder grips.
According to our results, nearly 90% of the participating surgeons utilize palm grip suturing to some extent, and a majority (81%) of the surgeons alternate between the finger grip and the palm grip, thus indicating the need for a needle holder designed for both the finger grip and the palm grip. Merely 2 surgeons were familiar with the palm grip release by the thenar eminence, suggesting that the current instruments fail to offer surgeons a suitable alternative for palm grip release.

Moreover, we found that a significant majority (75%) of the participating surgeons preferred to suture with the FNH rather than with the CWNH after merely suturing in porcine skin and small bowels for approximately 1 h. An even larger majority (97%) stated that they found an advantage using the FNH when suturing in the palm grip compared to the CWNH. Sader [1] suggested a modification of the HSNH by inserting a spring between the legs, hence facilitating palm grip release by the thenar eminence, supposedly with the same benefits as when employing the FNH for palm grip release. However, our study showed that merely 16% of the surgeons chose to disengage the FNH with the thenar eminence when the option to compress the opposed shanks for palm grip release was given. The FNH is thus thought to present an eligible alternative to the traditional needle holders by means of its versatility, especially regarding palm grip release.

Notably, 10 surgeons experienced an advantage when suturing in the finger grip, which was not anticipated. When asked, the surgeons with this attitude declared that they favored the spring and the related tactile feedback when suturing in the finger grip. In contrast, those 6 surgeons who experienced a disadvantage when suturing in the finger grip with the FNH stated that it was due to the feeling of working against the spring and hence the instrument. Overall, 81% of the surgeons thought that the FNH was superior or equal to the CWNH when suturing in the finger grip. Nonetheless, 3 surgeons did not prefer to suture with the FNH despite stating that they found advantages when employing the FNH for palm grip suturing: they said that they were either not interested in palm grip suturing (n = 1) or experienced disadvantages when employing the FNH in the finger grip (n = 2). Two additional surgeons stated that they experienced a disadvantage when suturing in the finger grip, but would still prefer to suture with the FNH.

We found a statistically significant difference in preference, in favor of the FNH compared with the CWNH, after a strictly limited suturing time. Our findings should be related to the fact that the participating surgeons have been working with the traditional needle holders for up to as many as 30 years, in contrast to the FNH, which was presented to them for the first time during the test. Furthermore, the compression of the opposed shanks for palm grip release seems to constitute a natural and obvious movement, since 87% of the participating surgeons preferred this alternative for palm grip release. In addition, we observed that several surgeons tried to disengage the ratchet mechanism of the CWNH by compressing the opposed shanks when alternating between the two instruments, further supporting the natural element of this maneuver.

Our findings are based on surgeons’ experience of the FNH after suturing on postmortem porcine skin and bowels in a context different from the actual clinical setting. This constitutes a limitation of the study. Further studies regarding the eligibility and possible advantages/disadvantages after long-term use in an actual clinical setting are desirable.

Surgical precision is a cornerstone of safe and effective surgery. In the present study, we found no significant difference in accuracy between the finger grip and the palm grip using the FNH. This finding is somewhat in contrast to a study by Seki [3] reporting that surgical precision is higher in surgeons using the palm grip compared to those using the finger grip. However, in that study, the grip preference of the surgeons decided whether they were allocated to the suture with the palm grip or suture with the finger grip group. In our study, too few surgeons habitually suture in the palm grip to make a similar comparison. Instead, all...
surgeons sutured using both the palm grip and the finger grip, regardless of their surgical grip preference. In this context, it should be noted that we found identical surgical precision in spite of the fact that the majority of surgeons habitually suture using the finger grip. It is also interesting to note that Seki [3] observed that an equivalent accuracy was obtained using both types of grip when wavering was allowed. Seki [3] suggested that the more accurate suturing in the palm grip was dependent on the more stable triangle obtained when gripping the needle holder using the palm grip and the possibility of grasping the needle holder at any part. This notion could help explain why we found that 10 surgeons preferring the finger grip sutured more accurately using the palm grip.

Disclosure Statement

C.-F.F.R. is a chairholder in Techmentum AB, which owns the patent rights for the FNH. B.J. and H.T. declare no conflicts of interest.

References