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Closure of skin with simple interrupted Prolene suturing versus subcuticular continuous Monocryl suturing after ORIF of distal radius fractures

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ABSTRACT

Objectives: The aim of the study was to assess the effects of subcuticular absorbable versus interrupted non-absorbable sutures for skin closure after distal radius fracture (DRF) fixation surgery in adults on post-operative pain, hand function, scar satisfaction, wound inflammation, and adverse events.

Methods: A retrospective study was conducted with 65 patients undergoing DRF surgical treatment between March 2022 and December 2022. Patients were divided into two groups: Traditional interrupted suture with Prolene® (n = 27) and subcuticular continuous suture with Monocryl® (n = 38). Pain intensity, complications, and cosmetics were evaluated.

Results: Subcuticular continuous suture with Monocryl® was superior to traditional interrupted suture with Prolene® in terms of the number of complications and esthetic and functional outcomes.

Conclusion: This study concluded that the subcuticular suturing with absorbable monofilament Monocryl® proved advantageous compared to simple interrupted suturing with Prolene® because it presented better results regarding pain intensity and esthetic results, with fewer complications.

Keywords: Distal radius fracture, Internal fixation, Open fracture reduction, Skin closure, Suture

INTRODUCTION

Distal radius fracture (DRF) is a common wrist injury. Recent data from the United States has stated that DRFs are the most common fractures.[1] With the introduction of new osteosynthesis materials and a better understanding of the biomechanics of the radiocarpal joint, the surgical treatment of radius fractures has significantly increased in the last three decades.[2-4] It is now understood that treating a DRF employing traction, reduction, and immobilization does not always lead to a good functional result.[2-4]

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At present, placing volar locking plates using a modified Henry approach is one of many options for treating articular and extra-articular DRF.[2-4] There are many different skin closure techniques for open reduction internal fixation (ORIF) of DRF, which include different and diverse materials that seek to minimize complications, reduce surgical time and optimize the esthetic result.[5] Today, no studies looked for the ideal suture material and technique. This study aimed to evaluate the effects of absorbable subcuticular versus non-absorbable interrupted sutures for skin closure after DRF fixation surgery.

MATERIALS AND METHODS

This retrospective study was conducted in a public hospital in Mexico City from March 1, 2022, to December 1, 2022. All patients who underwent ORIF for DRF were included in the study under the supervision of the researchers.

The patients were divided into two groups in even or odd numbers. In Group A patients, the incision was closed with non-absorbable polypropylene (*Prolene®, Ethicon US, New Jersey*) No. 4 suture material using simple interrupted sutures. In Group B, the incision was closed with an absorbable polylactide-polyglycolide copolymer (*Monocryl®, Ethicon US, New Jersey*) No. 4 by continuous subcuticular suture according to the preference of wound closure of the researcher on call.

The inclusion criteria were: Patients who underwent an ORIF of a DRF, aged 18–85 years, of both genders. The exclusion criteria were: Patients diagnosed with open DRF, previous ipsilateral forearm surgeries, and people who did not complete the 6-month follow-up.

Eight out of the 73 patients who met the inclusion criteria were excluded because they did not complete the 6-month follow-up, leaving 65 patients in the study.

The participants were clinically and radiographically evaluated in the hospital emergency department and followed the same standard pre-surgical and post-surgical care protocol. The surgical intervention preparation included using an anti-edema bandage, as well as immobilization with a volar splint, antimicrobial prophylaxis with cephalothin 30 min before the incision, and performing a modified Henry's volar approach in all procedures [Figure 1].

All surgical wounds after ORIF were closed with either technique and suture material that was assigned to them, as previously stated, from proximal to distal. After closure, the wound was covered with sterile gauze and a compression bandage. Patients were instructed not to remove the dressing until after 14 days in the first post-operative visit. None of the patients removed the dressing, and none had any signs of tampering or attempted removal.

Patients were reassessed at 24 weeks in terms of visual analog pain scale (where 10 = maximum intensity pain and 0 = no pain) and wound healing progress (dehiscence, surgical site infections, and adhesions) using the third version of the Patient and Observer Scar Assessment Scale (POSAS 3.0).[6] This standardized scale consists of a section oriented to patients and another section to the evaluation by the practitioner. The final result is derived from the sum of both, ranging from 6 to 60, where a higher number indicates a worse esthetic and functional result.

The data were recorded in Google Sheets and the results were presented in tables for further analysis.

The normality of the sample was demonstrated using the Shapiro–Wilk test. The variables were analyzed using the R software, and the Turkey SHD function was calculated using ANOVA. $P < 0.05$ was considered statistically significant.

RESULTS

Regarding the demographic study, only the age and gender of the patients were considered [Table 1]. Nearly half of the patients (49.2%) were females ($n = 32$), and 50.8% were males ($n = 33$). The mean age was 45.4 years (range 19–80).

Esthetic and functional analysis of the wound

For the esthetic and functional evaluation of the wound, the POSAS 3.0 scale was used. On the observer scale, in the

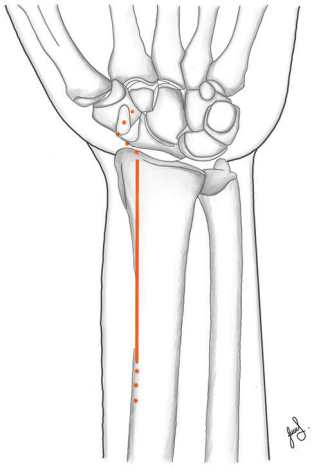

Figure 1: Henry's modified approach.

Table 1: Comparison between the two groups.

	Simple interrupted Prolene suturing	Continuous subcuticular Monocryl suturing
n	27	38
Gender ratio F:M	16:11	16:22
Mean age (years)	45.74	45.16

Table 2: Mean results of POSAS 3.0 in both groups.

	Observer scale			Patient scale						Results
				"At this moment" (24 weeks after surgery)			"During the last week"			
	Total	Female	Male	Total	Female	Male	Total	Female	Male	Total
Simple interrupted Prolene suturing	14.89	15	14.73	5.11	5.25	4.91	18.41	18.43	18.36	**38.41**
Continuous subcuticular Monocryl suturing	11.36	10.13	12.27	7.13	7.81	6.63	10.53	10.31	10.68	**29.03**

POSAS: Patient and Observer Scar Assessment Scale, The mean results for the subcuticular continuous suture with Monocryl® was 29.03 (range 12-42), while for the interrupted suture with Prolene® was 38.41 (range 22-56).

Table 3: Mean comparison and standard deviation of the visual analog scale results in both groups.

	Simple interrupted Prolene suturing	Continuous subcuticular Monocryl suturing
Minimum	0	0
Maximum	3	3
Average	1.48	1.37
±SD	1.01	0.94

subcuticular continuous suture with Monocryl®, the mean result in females was 10.13, and for males was 12.27. In the interrupted suture technique with Prolene®, the mean result in females was 15, and for males, it was 14.73. The overall mean results of the observer scale in the subcuticular continuous suture with Monocryl® was 11.36, and for the interrupted suture using the Prolene® was 14.89.

In the patient scale "at this moment" (24 weeks after surgery), in the subcuticular continuous suture with Monocryl®, the mean result in females was 7.81, and for males, it was 6.63. In the interrupted suture using the Prolene®, the mean result in females was 5.25, and for males, was 4.91. The overall mean results of the subcuticular continuous suture using Monocryl® was 7.13, and for the interrupted suture using the Prolene® technique was 5.11.

In the patient scale "during the last week," in the subcuticular continuous suture with Monocryl®, the mean result in females was 10.31, and for males, was 10.68. In the interrupted suture with Prolene®, the mean in females was 18.41, and 18.36 for males. The overall mean results for the subcuticular continuous suture with Monocryl® was 10.53, and for the interrupted suture using the Prolene® technique was 18.41 [Table 2].

The mean results for the subcuticular continuous suture with Monocryl® was 29.03 (range 12–42), while for the interrupted suture with Prolene® was 38.41 (range 22–56). There was a significant difference between the subcuticular continuous suture with Monocryl® and the interrupted suture with Prolene® ($P = 0.000033$).

Pain intensity

Pain intensity was assessed using the visual analog pain scale 24 weeks after surgery. Higher pain intensity was reported in patients with the interrupted suture with Prolene®, with a mean of 1.48, compared with the subcuticular continuous suture using Monocryl®, with a mean of 1.37. However, the groups had no statistically significant difference ($P < 0.05$) [Table 3].

Complications

In the interrupted suture with simple stitches technique group, 62% ($n = 17$) of the patients presented with complications, the most prevalent being carpal tunnel syndrome in 33.33% ($n = 9$). 22.22% ($n = 6$) presented with a hypertrophic scar, 14.81% ($n = 4$) with adhesions, 7.41% ($n = 2$) atrophic scar, 3.70% ($n = 1$) keloid scar, and one patient presented with dehiscence and early surgical site infection.

In the continuous absorbable group, 34% of the patients presented with complications. 10.52% ($n = 4$) hypertrophic scar, 7.89% ($n = 3$) carpal tunnel syndrome, 10.52% ($n = 4$) atrophic scar, and 7.89% ($n = 3$) presented with adhesions [Table 4].

DISCUSSION

POSAS observer scale takes into account the physical aspects of the scar, such as pigmentation, surface, texture, firmness, adhesion, tension, stretching, and visible marks.[6,7] POSAS patient Scale "At this moment" (for this particular study, the scale was performed 24 weeks after surgery) takes into account physical aspects at the time of the review, such as color, shine, surface, irregularity, and stretching of the scar, and POSAS Patient Scale "During the last week" takes into account aspects such as pain, burning, itching, paresthesias, fragility, and dryness during the past week.[6]

POSAS patient scale "At this moment" was better in the interrupted suture using Prolene®, which differs from the expected results and the investigators' evaluation. We can attribute this subjective result to the patients' expectations of having an almost invisible scar regarding an absorbable suture.[5] Women (from their perspective) obtained slightly worse results than men. This is to be expected due to greater esthetic importance.[5,8]

Pain intensity was evaluated using the visual analog scale[6,9] 24 weeks after surgery. There was no statistically significant

Table 4: Complications in both groups.

Complication	Simple interrupted Prolene suturing	Percentage	Continuous subcuticular Monocryl suturing	Percentage	Total
Carpal tunnel syndrome	9/27	33.33	3/38	7.89	12/45
Hypertrophy	6/27	22.22	4/38	10.53	10/45
Atrophy	2/27	7.41	4/38	10.53	6/45
Dehiscence	1/27	3.70	0		1/45
Adhesions	4/27	14.81	3/38	7.89	7/45
Surgical site infection	1/27	3.70	0	-	1/45
Keloid scar	1/27	3.70	0	-	1/45
Total	24/27	88.9	14/38	36.8	38/45 (84.4%)

difference between both groups. However, the pain score was lower in the subcuticular continuous suture using the Monocryl® group. Both groups had a low level of pain at 24 weeks post-surgery.

As for complications, the carpal tunnel syndrome complication was more common in the interrupted suture using the Prolene® group (n = 9) than in the subcuticular continuous suture using the Monocryl® group (n = 3), and its highest prevalence was in the 59–65-year-old group. Compared to the incidence reported in the literature,[10] we can state that using this type of suture material and technique decreases the incidence of carpal tunnel syndrome, which can be attributed to a decrease in adhesions and has the same risk of wound complications as non-absorbable sutures.[11,12] All of the above translates to another important advantage when using this closure technique. The second most frequent complication was hypertrophic scar, also more prevalent in the interrupted suture with simple stitches using the Prolene® group. In contrast, the atrophic scar was more prevalent in the group of subcuticular continuous suture using the Monocryl®. The rest of the complications were more prevalent in the interrupted suture with simple stitches using the Prolene®, as shown in [Table 4].

The interrupted suture with Prolene® presented more complications than the subcuticular continuous suture with Monocryl® group, even though there were more patients in the subcuticular continuous suture with Monocryl®. These results are compatible with the results of other studies.[11-13] In both groups, female patients had more complications. It can be attributed to age, gender, or by the number of participants in that gender [Table 5]. In the subcuticular continuous suture using the Monocryl® group, there was the same number of complications in both genders. However, the number of female patients was lower, and the mean age was higher.

In both groups, the average age was higher in the female gender, indicating that older women are at increased risk of fracture as well as young men.[1] The age range in which more complications occurred in the interrupted suture using the Prolene® group was 59–65 years, with a total of 6 complications [Table 6]. In the subcuticular continuous suture with Monocryl® group, the age groups with the highest prevalence of complications were 25–30 years, 45–51 years, and 59–65 years, with three complications in each of the mentioned age groups.

Table 5: Comparison of complications between males and females in both groups®.

Complications in the simple interrupted Prolene suturing			
Gender	***n***	**Mean age**	**Complications**
Males	11	27	7
Females	16	58	17
Complications in the continuous subcuticular Monocryl suturing			
Gender	***n***	**Mean age**	**Complications**
Males	22	34	7
Females	16	60	7

Table 6: Comparison of the number of complications and age range in both groups.

Age range	Complications in the simple interrupted Prolene suturing technique	Complications in the continuous subcuticular Monocryl suturing technique
18–24	4/27	1/38
25–30	2/27	3/38
31–37	1/27	0
38–44	1/27	0
45–51	3/27	3/38
52–58	2/27	2/38
59–65	6/27	3/38
66–72	3/27	2/38
73–79	1/27	0
80–86	1/27	0
Total (%)	24/27 (88.9)	14/38 (36.8)

Some limitations in this article include the small number of patients that were part of this study, which was carried out in a single hospital that spanned a 9-month period, which can impact the significance of the presented results. This limitation could be furtherly resolved in a multicenter study

that includes a longer period of time and could net similar results, since the article can be reproduced and the results project to be similar to what was found in this article.

Another limitation of this article is the presence of confounding variables, as both the closure technique and material used could be further subdivided into four categories: Simple interrupted suture with both Prolene® and Monocryl® and continuous subcuticular suture with Prolene® and Monocryl® to conclude which of the suture technique or the material used has the biggest advantages and less incidence of complications. This limitation could as well be resolved in another study aimed at comparing all four variables instead of these two.

Continuing with the study limitations, patients who had risk factors that could impact wound healing, such as medications (steroids), decreased immune response (diabetes), or other predisposing risks, were not excluded from this study. Since mean age and gender were similar in both groups and with complications, these two factors should not be mentioned as limitations.

CONCLUSION

This study concludes that Monocryl® absorbable subcuticular suture is superior to Prolene® interrupted suture with simple stitches in terms of pain, cosmetic appearance, patient satisfaction, and reduction of post-surgical carpal tunnel syndrome. Another benefit of using absorbable sutures, is that it eliminates the need for suture removal, which could confer considerable savings to patients and healthcare providers alike. As was previously stated in the study limitations, another rigorously-performed, non-inferiority randomized trial that includes economic analysis can be performed to conclude the best choice of sutures material and technique.

AUTHORS' CONTRIBUTIONS

AG conceived and designed the study, conducted research, and collected and organized data, wrote the initial and corrected draft of the article. MGR and CS provided logistic support, provided research materials and wrote the initial draft of the article. MB and CS conducted research and collected and organized data. FD analyzed and interpreted data and wrote the initial and corrected draft of the article. CM wrote the initial and corrected draft of the article and provided research materials. LCL provided research materials and provided logistic support. All authors have critically reviewed and approved the final draft and are responsible for the manuscript's content and similarity index.

ETHICAL APPROVAL

This retrospective study did not require ethical approval, following local law statutes.

DECLARATION OF PATIENT CONSENT

The authors certify that they have obtained all appropriate patients consent forms for this study. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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CONFLICTS OF INTEREST

There are no conflicting relationships or activities.

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