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Comparative analysis of exposed versus buried kirschner wire fixation for distal radius fractures

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Abstract:
Exposed or buried Kirschner wire (K-wire) fixation in distal radius fractures is debated. A Modified Mayo Wrist Score study of 40 patients compared functional results and complication rates to evaluate these techniques. The buried K-wire group had better functional recovery at one month, but both groups did well by six months. Both methods provided stable fixation, but exposed wires had a 30% risk of superficial infection and buried wires a 10% risk of hardware impingement. Thus, surgeons must weigh these complications against outpatient wire removal when choosing a technique.

Keywords: Distal radius fracture, mayo wrist score, modified oppenheim classification

Background:
Distal radius fractures are very common orthopaedic injuries and significantly impair wrist function and daily activities **[1].**Kirschner wire (K-wire) fixation is used commonly for fracture stabilisation as it offers reliable anatomical reduction and is cost effective **[2].** The most frequent complication of this procedure is a superficial pin-site infection, which in the past has been reported to occur in as many as 18.6% of cases **[3].** The K-wires are exposed and can be removed easily in the outpatient setting but they also provide a direct route for bacterial colonisation from skin flora **[4].** The subcutaneous K-wire burial creates a physical barrier to pathogens, but requires a second procedure for hardware removal **[5].** Recent meta-analyses show ongoing clinical uncertainty regarding which post-implantation management strategy best promotes patient safety without jeopardising functional recovery **[6].** Therefore, a systematic evaluation of complication profiles and long-term functional outcomes is paramount to inform evidence-based fixation protocols **[7].** Therefore, it is of interest to assess and compare the functional outcomes and complication profiles of exposed and buried Kirschner wire fixation in patients with distal radius fractures due to the ongoing clinical debate of pin-site infection risks versus hardware impingement.

Methodology:
Study design:
The aim of this analytical cross-sectional study was to evaluate the outcome of distal radius fractures managed with K-wire fixation in a tertiary care center for a period of 24 months.

Study participants:
Forty adult patients (mean age 43.37±13.26 years) with isolated fractures of the distal end of the radius were included in the study. The patients were randomly assigned to two equal groups of 20 patients each, with 20 patients having buried K-wires and 20 patients having exposed K-wires.

Inclusion criteria:
Inclusion criteria were patients ≥18 years of age with isolated lower end radius fracture and planned treatment with K-wire fixation alone.

Exclusion criteria:
Exclusion criteria included patients less than 18 years of age and those with compound or pathological fractures or with cognitive impairment suggestive of inability to comply with trial procedures or complete follow-up questionnaires.

Data collection:
The detailed demographic data, clinical history and baseline radiological assessments were recorded on a pre-structured proforma. Under regional anaesthesia traction counter traction was used to achieve fracture alignment confirmed by image intensifier. Stabilisation was performed with percutaneous K-wires, 1.5 mm or 2.0 mm. In the exposed cohort the wire ends were bent and left protruding outside the skin. In the buried cohort the wires were bent and buried subcutaneously. Post-operatively, standard below-elbow volar slab immobilisation was applied.

Follow-up:
Initial pin site inspection was performed on weekly basis. Standard clinical and functional assessments were performed at 1, 3 and 6 months after surgery. K-wires were usually removed 4–6 weeks after radiological evidence of union.

Outcome measures:
Objective functional outcome was assessed using the Modified Mayo Wrist Score. Post-operatively, the incidence and severity of pin tract infections were graded according to the Modified Oppenheim Classification.

Ethical considerations:
The study was conducted in accordance with the ethical standards laid down in the Declaration of Helsinki and Ethical approval was obtained from the Institutional Ethics and Research Committee. All participants provided written informed consent before being enrolled.

Table 1: Demographic distribution of the study population

Variable	Buried K-Wire (n=20)	Exposed K-Wire (n=20)	Total (n=40)
Mean Age (Years ± SD)	45.05 ± 12.24	41.70 ± 14.33	43.37 ± 13.26
Gender (Male/Female)	11 / 9	8 / 12	19 / 21
Side Involved (Right/Left)	8 / 12	7 / 13	15 / 25

Table 2: Comparison of modified mayo wrist scores over time

Follow-Up Interval	Buried K-Wire (Mean ± SD)	Exposed K-Wire (Mean ± SD)	P-Value
1 Month	71.50 ± 6.90	66.25 ± 5.10	0.032
3 Months	78.75 ± 7.23	78.50 ± 6.50	0.900
6 Months	86.25 ± 9.16	87.50 ± 7.86	0.620

Table 3: Incidence of superficial pin-site infections

Cohort	Infection Present	Infection Absent	Total
Buried K-Wire	3 (15%)	17 (85%)	20
Exposed K-Wire	6 (30%)	14 (70%)	20

Table 4: Post-operative complications profile

Complication Type	Buried K-Wire (n=20)	Exposed K-Wire (n=20)	Total (n=40)
None	17 (85%)	17 (85%)	34 (85%)
Joint Stiffness	1 (5%)	1 (5%)	2 (5%)
Pin Tract Infection	0 (0%)	2 (10%)	2 (5%)
Wire Impingement	2 (10%)	0 (0%)	2 (5%)

Table 5: Modified oppenheim classification grading

Grade	Buried K-Wire (n=20)	Exposed K-Wire (n=20)	Description
None	18 (90%)	0 (0%)	No signs of complication
Grade 1	0 (0%)	20 (100%)	Slight discharge/redness
Grade 4	2 (10%)	0 (0%)	Severe soft tissue involvement

Results and Discussion:

The distal radius fracture is a very frequent presentation requiring precise stabilisation for optimum recovery, as highlighted by Nellans *et al.* **[1]** and Sahib *et al.* **[3].** The study included 40 patients, 20 in the buried K-wire group and 20 in the exposed K-wire group, with a mean age of 43.37 ± 13.26 years **(Table 1).** This pattern of demographic distribution is in agreement with the results of Khan *et al.* **[8]** who reported statistically similar age and gender profiles in their large cohorts of upper extremity fractures.

The functional recovery evaluated with the Modified Mayo Wrist Score, demonstrated a significant progressive improvement in the six months follow-up period in both cohorts **(Table 2).** The buried K-wire group had statistically better functional results than the exposed group at one month follow up (71.50 ± 6.90 vs 66.25 ± 5.10, p=0.032). However, functional outcomes were equalised at three and six months. This eventual functional equivalence correlates strongly with the meta-analysis of Hidajat *et al.* **[6]** who concluded that long-term functional restoration is independent of K-wire burying status. Infectious complications varied significantly between the 2 surgical modalities **(Table 3).** Pin site infection was more common in the exposed K-wire group (30%) compared to the buried group (15%) a doubling of the rate. Both Maradei-Pereira *et al.* **[5]** and Ridley *et al.* **[9]** found exposed hardware as a major independent risk factor for pin-tract colonisation, lending support to the increased susceptibility of exposed wires. However, a 2024 review of 11 studies that involved 2,022 patients concluded that although the relative risk of pin-site infection is significantly reduced by burying K-wires, the primary surgical duration and the total number of days until the pins are finally removed are significantly increased **[6].** There were differences in superficial infections but the overall rate of severe post-operative complications was low for both modalities **(Table 4)**. Exposed wires could be infected. We had unique mechanical problems of buried wires, *i.e.* wire impingement (10%). Similarly, Abdullah *et al.* **[10]** found that burying the wires decreased the infection rate but often caused mechanical irritation, necessitating secondary operative procedures. This economic clinical trade-off is well supported by a recent 2026 meta-analysis **[11]** that showed that although exposed K-wires have a higher absolute infection risk (~10.7% vs. ~5.6%), they are still significantly more cost-effective by completely avoiding the routine secondary surgical procedure, anaesthesia and operating room costs associated with hardware removal. Another meta-analysis from 2022 indicated that exposed Kirschner wire osteosynthesis resulted in a significantly higher infection rate than buried Kirschner wire osteosynthesis **[12].** Infections and complications were graded by severity using Modified oppenheim classification **(Table 5)**. All patients in the exposed K-wire cohort (100%) experienced mild, Grade 1, local reactions. Conversely, the buried cohort was mostly asymptomatic (90%) but uniquely had Grade 4 complications (10%) with extensive soft tissue involvement. This dichotomous risk profile emphasises the need for clinical decision-making to balance the ubiquitous nuisance of minor infections associated with exposed wires and the rare but serious risk of hardware impingement with buried wires. This sentiment has been echoed in recent literature by Kulkarni *et al.* **[7].** Furthermore, a systematic review of upper extremity fractures in 2025 highlighted that surgeons need to balance the clinical benefit of lower superficial infection rates against the logistical problems and patient anxiety associated with the removal of surgical pins, especially in paediatric or sensitive populations where the ultimate functional results are comparable across different techniques **[3]**.

Conclusion:

Both exposed and buried Kirschner wire fixation methods stabilise distal radius fractures with acceptable long-term function. Buried K-wires reduce superficial pin-site infections and improve functionality early on, but they can cause hardware impingement requiring secondary surgery. One must weigh the convenience of outpatient exposed wires against surgery complications.

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