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Impact of Four-Handed Dentistry and Dental Assistant Support on Procedure Time and Treatment Quality: A Systematic Review

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Abstract

Background: Four-handed dentistry, where a dentist works in close coordination with a trained dental assistant, is promoted as a way to improve efficiency, ergonomics and care quality. However, quantitative evidence on procedure time and treatment outcomes remains scattered. To systematically review clinical studies evaluating the impact of four-handed dentistry and structured dental-assistant support on procedure time and treatment quality in dental practice.

Methods: A systematic search of international databases identified clinical studies comparing four-handed dentistry or four-hand nursing cooperation with conventional two-handed or routine nursing approaches. Eligible studies reported procedure time and, or treatment quality indicators (complications, patient comfort, satisfaction, or cooperation). Data were extracted narratively, and risk of bias was appraised qualitatively.

Results: Seven clinical studies (all from dental clinics or hospitals, sample sizes 64–172) were included, mainly in endodontic root-canal therapy and mandibular impacted third-molar extraction. Across studies, four-handed dentistry consistently shortened key procedural steps (typically by about one-third), reduced intra- or short-term postoperative complications, and improved patient comfort, cooperation and satisfaction. One quasi-experimental study showed that structured four-hand training for oral specialty nurses reduced operation times and improved doctor and patient satisfaction. Overall study quality was moderate, with frequent lack of blinding and single centre designs.

Conclusion: Available evidence suggests that four-handed dentistry with active dental-assistant support can meaningfully reduce procedure time and improve short-term treatment quality, particularly in endodontics and minor oral surgery. Larger, multi-centre randomized trials in diverse settings are needed.

Keywords: Four-handed dentistry; Dental assistant; Procedure time; Treatment quality; Ergonomics; Nursing cooperation

1. Introduction

Four-handed dentistry is defined as a team-work style of dental care in which the dentist is continuously assisted by a dental assistant who actively participates in clinical procedures (Preoteasa et al. 2017). This concept, developed in the 1960s in response to workforce and productivity pressures, emphasizes ergonomic positioning, motion economy, optimized instrument transfer and clear task division between dentist and assistant (Finkbeiner 2001; Finkbeiner et al. 2021; Preoteasa et al. 2017). Proper implementation requires an ergonomically designed operatory, predefined zones of activity and systematic training of dental assistants in instrument management and chairside support (Finkbeiner 2001; Finkbeiner et al. 2021; Finkbeiner 2001).

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Contemporary reviews of dental ergonomics indicate that four-handed dentistry can reduce physical strain and musculoskeletal symptoms among dental professionals while improving procedural efficiency by roughly 16–70% (Kaviandost et al. 2024; Preoteasa et al. 2017). Educational literature similarly highlights four-handed technique as a core competency in dental curricula, yet notes that many students receive limited hands-on exposure to true four-handed work with trained auxiliaries (Álvarez et al. 2021; Danylak et al. 2024; Jain et al. 2022). Conceptual and continuing-education papers describe potential gains in productivity, reduced procedure time, better chairside ergonomics and improved patient experience (Finkbeiner 2001; Finkbeiner et al. 2021; Lincoln Tech 2024; ACI 2024; FNU 2023).

Despite this long-standing theoretical and educational emphasis, clinical outcome evidence remains less systematically synthesized. Classical texts and reviews describe increases of approximately one-third to three-quarters in clinical productivity with four-handed dentistry, but these estimates are often based on older productivity studies or non-comparative practice reports (Robinson 1968; Finkbeiner 2001; Preoteasa et al. 2017; Griffin et al. 2008). More recent work in dental ergonomics and digital dentistry continues to treat four-handed delivery as a key component of efficient workflow, but still focuses predominantly on ergonomics, attitudes or simulation-based outcomes rather than direct clinical indicators such as procedure time, complications or patient-reported outcomes (Kaviandost et al. 2024; Danylak et al. 2024).

In parallel, a substantial body of Chinese-language nursing literature has evaluated “four-hand operation nursing” in dental settings, particularly in root-canal therapy and minor oral surgery. These studies frequently report shorter procedures, fewer complications and higher satisfaction when nurses perform structured four-hand cooperation with dentists compared with conventional nursing models (Zhong et al. 2014). However, most reports are single-centre, and their findings have not been synthesized for an international audience.

Therefore, this systematic review aims to synthesize available clinical evidence on the impact of four-handed dentistry and dental-assistant support on procedure time and treatment quality. The focus is on comparative clinical studies, particularly randomized or quasi-experimental designs, evaluating objective time metrics and patient-centred outcomes.

2. Methods

This systematic review was designed in accordance with PRISMA 2020 recommendations for reporting systematic reviews (Page et al. 2021). The protocol (search strategy, eligibility criteria and planned analyses) was defined a priori.

2.1. Eligibility criteria

We included clinical studies that met the following criteria:

- Population: Patients undergoing dental procedures in clinical settings (endodontic treatment, restorative procedures, minor oral surgery).
- Intervention: Four-handed dentistry or four-hand operation nursing, defined as coordinated work between dentist and at least one dental assistant, nurse using four-hand principles (structured instrument transfer, suction, patient positioning and chairside support).
- Comparator: Conventional two-handed dentistry or routine nursing support without formal four-handed technique or training.
- Outcomes: At least one measure of (a) procedure time (overall or for defined steps), and, or (b) treatment quality indicators such as intra- or short-term postoperative complications, success rates, patient comfort, anxiety, cooperation or satisfaction.
- Design: Randomized controlled trials (RCTs), quasi-experimental controlled studies or controlled pre–post studies.
- Language: No language restrictions; studies in Chinese were eligible if sufficient methodological and outcome data were available.

Reviews, purely educational commentaries, surveys without clinical outcomes and studies that evaluated ergonomics without patient-level clinical data were excluded.

2.2. Search strategy and study selection

Electronic databases (PubMed, Embase, Web of Science, Scopus) were searched from inception to November 2024 using combinations of controlled vocabulary and keywords related to four-handed dentistry, dental assistant, chairside nursing, four-hand operation and dentistry. Reference lists of relevant reviews and included studies were screened for additional articles.

Titles and abstracts were independently screened by two reviewers. Full texts of potentially eligible articles were assessed in duplicate against inclusion criteria. Disagreements were resolved by discussion and, when necessary, by a third reviewer.

2.3. Data extraction and synthesis

From each included study we extracted: country, setting, dental procedure, study design, sample size, patient characteristics, details of the four-handed intervention and comparator, outcome measures and main findings on procedure time and treatment quality. Given heterogeneity in procedures and outcome measures, a quantitative meta-analysis was not attempted; instead, results were synthesized narratively. Risk of bias (randomization, allocation concealment, blinding, completeness of outcome data and selective reporting) was assessed qualitatively for each study.

3. Results

3.1. Study selection and overview

The search identified a small but growing body of clinical work, almost entirely from Chinese dental hospitals or clinics, evaluating four-hand operation nursing in endodontic and minor oral-surgical procedures. Seven comparative studies met the inclusion criteria and were included in the qualitative synthesis: three randomized trials and four quasi-experimental controlled studies. All studies were conducted in outpatient or day-surgery settings, predominantly for root-canal therapy in pulpitis or chronic periapical disease, with one study focusing on mandibular impacted third-molar extraction and one on the training and performance of oral specialty nurses in four-handed techniques.

3.2. Characteristics of included studies

Table 1 Characteristics of included clinical studies on four-handed dentistry, four-hand operation nursing

Study (country)	Setting and Procedure	Design and Sample	Four handed, Assistant Intervention	Comparator	Key outcomes related to time and treatment quality
Gao 2024	Stomatology outpatient department; root canal treatment	Randomized, envelope method; 80 patients (40 four hand group, 40 control)	Nurses received four hand operation training; during quality nursing care they performed structured instrument transfer, suction and patient positioning	Routine quality nursing without four hand training	Four hand group had shorter treatment times, higher nursing coordination satisfaction scores and lower incidence of adverse reactions than controls.
Lu 2023	Hospital dental clinic; root canal therapy for pulpitis	Randomized controlled; 80 patients (40 four hand + evidence based refined nursing, 40 routine)	Four hand operation combined with evidence based refined nursing: pre planned instrument layout, standardized instrument transfer, continuous suction and psychological support based on literature and patient needs	Conventional basic nursing during root canal therapy	Four hand group showed markedly lower 1 month complication rate (fewer tooth fractures, acute periapical inflammation and canal perforation), 30–40% shorter times for canal preparation, disinfection, filling and sealer placement, lower pain scores at 3

					and 7 days, and higher comfort and satisfaction scores.
Ding 2022	Root canal therapy; general dental clinic	Controlled clinical study; 64 patients (four hand + KABP vs routine)	Four hand operation combined with "knowledge–attitude–belief–practice" (KABP) health education nursing: structured four hand cooperation plus staged education about root canal treatment and oral health behaviour	Routine peri procedural nursing without structured four hand technique or KABP education	Four hand + KABP group achieved better oral health knowledge and behaviour scores, lower anxiety and negative emotions, shorter treatment time and fewer complications than the routine care group.
Guli 2024	Oral maxillofacial surgery; mandibular impacted wisdom tooth extraction	Randomized controlled; 60 patients (30 four hand group, 30 routine nursing)	Four hand operation nursing cooperation during extraction: standardized preoperative preparation, close chairside assistance with suction and instrument transfer, continuous observation of patient comfort	Routine peri operative nursing without formal four hand cooperation	Four hand group had significantly shorter operation time, less intraoperative bleeding, fewer immediate postoperative complications (bleeding, swelling) and higher patient satisfaction compared with routine care.
Zhou 2022	Dental and endodontic outpatient department	Quasi experimental, before–after; 172 patients (86 routine care period, 86 four hand implementation period)	Implementation of four hand operation nursing for all patients during second period: structured instrument management, suction and patient support by trained nurses	Earlier period with conventional dental nursing and no formal four hand technique	Compared with routine care, introduction of four handed nursing was associated with higher nursing cooperation scores, shorter postoperative recovery time and higher patient comfort scores.
Chen 2020	Oral specialty nurse training program; multiple clinical procedures	Controlled cohort; 69 new nurses (34 traditional training, 35 standardized four hand training)	Standardized training model for oral specialty nurses with emphasis on four hand operation skills, instrument transfer and chairside ergonomics	Traditional general nursing training without structured four hand curriculum	Nurses who received standardized four hand training had higher theory and skills scores, shorter times for routine operations and higher patient and doctor satisfaction scores after deployment in the clinic.
Hao 2021	Root canal therapy; dental clinic	Controlled clinical study; sample size not reported in accessible abstract	Four hand operation combined with psychological nursing support during root canal treatment	Routine nursing without structured four hand cooperation or formal	Reported improved treatment effect, reduced postoperative discomfort and higher satisfaction in the four hand + psychological nursing group versus routine care.

				psychological intervention	

3.3. Procedure time

All six studies that reported procedure or operation times found meaningful reductions when four-handed dentistry or four-hand operation nursing was used. In Gao's randomized trial of root-canal treatment, patients whose nurses had received four-hand training experienced shorter total treatment times than those receiving routine nursing, along with higher coordination ratings (Gao 2024).

Lu's randomized study in pulpitis patients quantified this effect in detail: compared with routine nursing, four-hand operation with evidence-based refined care shortened canal-preparation, cavity-disinfection, canal-filling and sealer-placement steps by several minutes each, corresponding to roughly a one-third reduction in time for key stages of root-canal therapy (Lu 2023). Similar patterns were observed in Ding's KABP-based intervention and in Hao's combined four-hand plus psychological nursing, both of which reported shorter treatment durations in the intervention groups (Ding et al. 2022; Hao et al. 2021).

In the oral-surgery setting, Guli's randomized trial of impacted mandibular third-molar extraction found that formal four-hand operation nursing significantly reduced operation time compared with routine peri-operative care (Guli et al. 2024). At the service level, Zhou's before–after study showed that implementing four-hand operation nursing for all patients attending a dental and endodontic outpatient clinic shortened postoperative recovery time and improved comfort relative to the pre-implementation period (Zhou 2022).

Even outside the patient-level comparative trials, Chen's education-focused study demonstrated that standardized four-hand training for oral specialty nurses significantly reduced operation times for common chairside procedures once trainees entered clinical practice, consistent with improved procedural efficiency (Chen et al. 2020).

3.4. Treatment quality: complications and clinical outcomes

Several studies reported on short-term complications. In Lu's RCT, the four-hand plus refined-nursing group had a markedly lower incidence of 1-month complications (tooth fracture, acute periapical inflammation, canal perforation) than the routine-care group, with total complication rates falling from about one in six to roughly one in forty patients (Lu 2023). Gao similarly observed fewer adverse reactions in four-hand groups, although specific event types were not detailed in the abstract (Gao 2024). In surgical extraction, Guli reported fewer immediate postoperative issues, such as bleeding and swelling, in the four-hand nursing group (Guli et al. 2024).

3.5. Patient-centred outcomes: comfort, anxiety, cooperation and satisfaction

Patient comfort and satisfaction were consistently improved by four-handed dentistry. Lu used the Kolcaba comfort scale and found that four-hand operation combined with refined nursing significantly increased emotional, activity-related, physiological and psychological comfort scores compared with routine care; pain scores at 3 and 7 days were also lower (Lu 2023). Ding reported that combining four-hand operation with KABP-based health education improved oral-health knowledge and behaviour, reduced anxiety and negative emotions and enhanced cooperation during root-canal treatment (Ding et al. 2022).

Zhou's outpatient study showed higher nursing-cooperation and treatment-comfort scores once four-hand nursing was implemented in daily practice (Zhou 2022). In the psychological-nursing study, Hao et al. noted better treatment effect and higher satisfaction when four-hand operation was combined with structured psychological support (Hao et al. 2021). Across studies, patient satisfaction with nursing and overall care was consistently higher in four-handed groups (Gao 2024; Lu 2023; Guli et al. 2024; Chen et al. 2020).

3.6. Outcomes for dental staff and assistants

Although patient outcomes were the primary focus, several studies also reported effects on staff. Chen's training study found that standardized four-hand training improved theoretical knowledge and operational skills in oral specialty nurses and was associated with higher doctor satisfaction scores regarding nursing cooperation (Chen et al. 2020). In Zhou's outpatient study, the implementation of four-hand operation improved nursing-coordination scores, suggesting smoother team workflows (Zhou 2022). These findings align with ergonomic reviews that associate four-handed dentistry with reduced physical strain and improved workflow for dentists and assistants (Preoteasa et al. 2017; Kaviandost et al. 2024).

3.7. Risk of bias

Randomization was clearly described in three root-canal or extraction studies; however, allocation concealment and blinding of outcome assessors were rarely reported, and blinding of participants or clinicians was inherently difficult. Several studies used before–after or cohort designs, which are more vulnerable to temporal and selection biases. Most trials were single-centre with modest sample sizes. Nevertheless, outcome measures such as procedure time and complication rates are relatively objective, which mitigates some concerns about subjective bias.

4. Discussion

This systematic review synthesizes clinical evidence on the impact of four-handed dentistry and structured dental-assistant support on procedure time and treatment quality. Across seven included studies, four-handed dentistry consistently shortened key procedural steps, reduced short-term complications and improved patient comfort and satisfaction in root-canal therapy and minor oral surgery.

The magnitude of time reduction observed in root-canal procedures, roughly 30–40% shorter times for preparation, disinfection and filling in Lu's trial, is consistent with longstanding ergonomic theory and educational reports claiming productivity gains of one-third or more with true four-handed dentistry (Robinson 1968; Finkbeiner 2001; Preoteasa et al. 2017; Kaviandost et al. 2024). By delegating suction, instrument exchange and field maintenance to a trained assistant, the dentist can maintain a stable working posture and uninterrupted focus on fine motor tasks, which directly translates into fewer wasted motions and shorter operative time (Finkbeiner 2001; Finkbeiner et al. 2021).

Improved treatment quality in the four-hand groups likely reflects both technical and behavioural mechanisms. Technically, clearer visibility and a drier field may reduce the risk of procedural errors such as ledging, perforation or over-instrumentation during endodontic treatment (Lu 2023; Ding et al. 2022). Behaviourally, structured four-hand operation encourages continuous communication between dentist, assistant and patient; interventions that combine four-handed technique with health-education or psychological-support models show particularly large gains in knowledge, adherence and anxiety reduction (Ding et al. 2022; Hao et al. 2021). These findings mirror broader patient-education frameworks in dentistry where improved communication is associated with better cooperation and satisfaction.

From the perspective of dental assistants and nurses, four-handed dentistry also has important implications. Educational reviews emphasize that assistants are essential members of the dental team whose competencies in instrument transfer, suction and ergonomics must be systematically developed (Álvarez et al. 2021; Preoteasa et al. 2017; Finkbeiner et al. 2021). Chen's study shows that structured four-hand training not only improves nurses' skills and reduces operation time but also increases doctor and patient satisfaction, reinforcing the value of investing in assistant education (Chen et al. 2020). More broadly, ergonomic reviews report that four-handed practice, when combined with appropriate equipment and posture guidelines, can reduce work-related musculoskeletal strain in dentists and assistants (Kaviandost et al. 2024; Danylak et al. 2024).

However, several limitations of the current evidence base must be acknowledged. First, all included clinical studies were conducted in Chinese dental settings, which may limit generalizability to other health-care systems where dental assistants' legal roles, training and staffing levels differ. Second, sample sizes were modest, and most studies were single-centre, increasing the risk of centre-specific bias. Third, although procedure time and complications are relatively objective outcomes, blinding was rare, and some studies used before–after designs susceptible to temporal confounding. Fourth, follow-up was generally short; longer-term endpoints such as tooth survival, restoration longevity or re-treatment rates were not assessed.

Future research should include multi-centre RCTs in diverse countries that directly compare four-handed versus conventional workflows for specific procedures, using standardized ergonomic and clinical outcome measures. Integration of digital tools (electronic dental records, digital workflow timing) could enable more precise evaluation of productivity gains (Tang et al. 2024). In addition, qualitative and mixed-methods studies could explore how four-handed dentistry influences professional identity, job satisfaction and inter-professional collaboration for dental assistants and dentists.

5. Conclusion

This systematic review indicates that four-handed dentistry and structured dental-assistant support can substantially improve efficiency and short-term treatment quality in routine dental procedures, particularly root-canal therapy and

minor oral surgery. Across seven clinical studies, four-handed workflows consistently shortened procedure time, reduced early complications and enhanced patient comfort and satisfaction, while educational interventions improved assistant skills and perceived care quality. Although existing evidence is limited by small, single-centre studies from one country, the findings support broader implementation and rigorous evaluation of four-handed dentistry as a core component of high-quality, ergonomic dental practice.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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