

Optimizing Workflow: The Surgical Technologist's Guide to Efficient Autologous Bone Graft Preparation

ANGELA ENOCHSON

With over two million orthopedic procedures involving bone grafting performed annually worldwide, autologous bone graft preparation represents one of the most frequently performed yet often overlooked tasks in orthopedic surgery.¹ For surgical technologists, the responsibility of processing harvested bone into implant-ready material carries significant implications for surgical outcomes, operating room efficiency, and patient safety. In an era marked by critical workforce shortages and mounting pressure to optimize operating room utilization, understanding how to streamline this essential task has never been more important.

BACKGROUND

Autologous bone, which is tissue harvested from the patient's own body, remains the gold standard for bone grafting procedures.² It is the only graft material that fulfills all three components of the tissue regeneration triad: osteogenesis, osteoinduction, and osteoconduction.² Unlike allograft from donors, autologous bone carries no risk of immunological rejection or disease transmission, making it the preferred choice for spinal fusion and orthopedic reconstruction. Over the past several decades, spinal fusion utilization has shown an upward trend, increasing the importance of efficient graft preparation and handling in the operating room.³

Surgical technologists play a critical role in preparing autologous bone for reimplantation. The process requires removing residual connective tissue and milling harvested bone into particles of appropriate size. These tasks are traditionally performed manually using periosteal elevators, rongeurs, curettes, and other sharp instruments. Research has shown that manual processing times vary significantly based on individual skill and efficiency, with wide variability depending on the surgical technologist.⁴ Studies also suggest that surgical technologists may underestimate their

LEARNING OBJECTIVES

- ▲ Understand the critical role of surgical technologists in autologous bone graft preparation
- ▲ Recognize the impact of efficient bone processing on surgical outcomes and operating room efficiency
- ▲ Describe the advantages of autologous bone grafting in orthopedic procedures
- ▲ Identify workflow optimization strategies for bone graft preparation
- ▲ Discuss how consistency and reliability in bone processing affects surgical workflow
- ▲ Evaluate methods to enhance safety during bone graft preparation

actual processing time, a tendency that can be amplified when bone preparation occurs in parallel with other intraoperative tasks.⁴ This variability may create unpredictable case durations in an environment where operating room time costs approximately \$46 per minute when adjusted to current dollars.⁵

A critical but often unrecognized contributor to variability in autologous bone graft preparation is cognitive load rather than technical skill. Bone processing rarely occurs as a single, uninterrupted task; instead, surgical technologists perform it in parallel with instrument passing, sterile field management, anticipation of surgeon needs, and ongoing team communication. Even experienced surgical technologists must frequently shift attention between competing intraoperative priorities, increasing susceptibility to interruption, time compression, and variability in manual task execution.

In this context, inconsistency in preparation time or graft quality should not be interpreted as a reflection of individual competence, but rather as a predictable outcome of performing precision manual work under high cognitive demand. Workflow strategies that reduce attentional burden, whether through task standardization, role clarity, or automation, therefore address a fundamental human-factors constraint inherent to the operating room environment. This aligns with established human-factors research demonstrating that divided attention and interruption increase variability in manual task performance, particularly in high-stakes environments such as the operating room.⁶

Automated bone processing systems such as Bone Mill+™ with Prep+™ offer an alternative approach, converting manual tissue removal and milling into standardized, automated tasks. These systems can help address the variability inherent in manual processing while reducing physical demands on surgical technologists.

Recent survey data underscore the operational impact of this variability, with the majority of practitioners reporting notable variation in graft preparation when different team members perform the task – even as most rate consistency in preparation time as important to OR efficiency.⁷ This challenge may be compounded by ongoing staffing shortages: in an American College of Healthcare Executives survey, 87% of hospital CEOs cited technician shortages as a workforce concern, and many facilities have turned to contract labor such as agency or traveling staff to help fill gaps.⁸ In this environment, standardized approaches to bone graft preparation have become

essential, not only to support surgical planning but also to integrate rotating team members while maintaining quality outcomes.

This CE article examines practical strategies for optimizing autologous bone graft preparation, focusing on workflow efficiency, processing consistency, and surgical technologist safety.

PRE-OPERATIVE PLANNING AND OR SETUP

Effective autologous bone graft preparation begins well before the first incision. Surgical technologists play a pivotal role in establishing an optimized operating room environment that supports efficient bone processing while maintaining sterility and safety standards. Survey data reinforces the importance of this preparatory work.⁷ Limited space in the sterile field (56%) and coordination challenges (56%) top the list of workflow obstacles surgical technologists identify – issues that deliberate pre-operative planning can address before they create intraoperative friction.⁷

Essential equipment for autologous bone processing includes bone harvesting instruments (rongeurs, curettes, osteotomes), automated bone milling devices, sterile collection basins, and irrigation supplies. The Association of Surgical Technologists guidelines recommend that furniture included in the sterile field be positioned a minimum of 12 inches away from the wall and other non-sterile furniture/equipment.⁹ The Association of periOperative Registered Nurses guidelines further emphasize reducing nonessential movement around the sterile field and positioning equipment within the airflow curtain to minimize contamination risk.¹⁰

When automated bone processing systems are utilized, strategic placement within the sterile field is critical. Notably, 44% of surgical technologists – compared to just 7% of surgeons – identify strategic equipment placement as a key efficiency strategy, highlighting this as a distinctly surgical technologists-visible lever for workflow optimization.⁷ Automated systems should be placed on the back table or on a dedicated Mayo stand, where the surgical technologists can operate them without compromising their ability to anticipate the surgeon's needs. This arrangement helps minimize unnecessary reaching, repositioning, and traffic around the sterile field while preserving clear access for the surgeon and assistant.^{9,10}

Prior to each procedure, a systematic verification checklist ensures equipment readiness and functionality.

This includes confirming that automated systems are properly assembled, power sources are connected and functioning, and all disposable components are within expiration dates and intact. The World Health Organization Surgical Safety Checklist framework provides a model for integrating equipment verification into standard pre-operative protocols, with studies demonstrating significant reductions in surgical complications when consistently implemented.¹¹ The U.S. Bureau of Labor Statistics notes that surgical technologists are responsible for preparing the operating room by setting up instruments and equipment and confirming proper function before surgery.¹²

Coordination with the surgical team during pre-operative briefings allows surgical technologists to clarify anticipated bone harvest timing and volume requirements. Understanding the planned fusion levels in spinal procedures, for example, enables appropriate preparation of processing capacity. Single-level lumbar fusions typically require 10-15 cc of processed bone graft, while multi-level procedures may require 30 cc or more.¹³ This advance knowledge allows surgical technologists to anticipate whether multiple processing cycles will be needed and plan workflow accordingly. When the environment is standardized, i.e., equipment positioned, readiness verified, expectations aligned, processing steps become easier to execute consistently, supporting predictable timing throughout the case.

TEAM COORDINATION AND COMMUNICATION

Effective coordination between surgical technologists and the broader operating room team is fundamental to efficient autologous bone graft procedures. Poor communication and unclear roles have been linked to inefficient collaboration, reduced performance, and increased errors, while suboptimal teamwork contributes to a significant proportion of preventable surgical complications.¹⁴

Survey findings reveal that coordination and timing present significant challenges during bone graft preparation, with surgical technologists reporting this concern at notably higher rates (56%) than surgeons (27%).⁷ This disparity likely reflects the surgical technologists' unique position managing multiple concurrent responsibilities while maintaining sterile field integrity and anticipating surgeon needs.

Parallel task management – performing bone preparation while simultaneously supporting other procedural demands – is common practice, as reported by approximately half of both surgical technologists (52%) and surgeons (47%).⁷ However, this multitasking approach creates inherent coordi-

nation complexities. One survey respondent described balancing manual graft preparation with instrument passing while ensuring quality bone is ready when the surgeon needs it as a skill “difficult to master for newer techs.”⁶ This experience reflects research findings that clear role designation and team stability enhance both accountability and surgical performance.^{14,15}

Despite the recognized importance of timing coordination, only 40% of respondents reported having clear timing protocols in place for bone graft preparation.⁷ Standardized communication protocols have demonstrated improvements in critical information transfer during staff changes, with one initiative increasing completion of critical handoff elements from 34% to over 95%.¹⁶

Automation offers a practical solution to these coordination challenges. Devices with predictable, consistent processing times enable surgical technologists to communicate reliable timeframes to the surgical team, facilitating better case planning and reducing the cognitive burden of managing variable manual processing while attending to other intraoperative responsibilities.

ACHIEVING CONSISTENT, RELIABLE RESULTS WITH AUTOMATED BONE PROCESSING

When different team members perform the same task, results can vary significantly. In the survey, 74% of respondents reported experiencing moderate-to-significant variation in bone graft preparation outcomes when different team members performed the task (Figure 1).⁷ This variability extends beyond quality to timing: an earlier survey found that surgical technologists often underestimate their manual bone processing time by approximately 14 minutes, which may make it difficult for surgical teams to plan procedures accurately.⁴

For surgical workflow, predictability matters as much as speed. Among surveyed practitioners, 69% rated consistency in bone graft preparation time as extremely or very important to their workflow.⁷ When preparation times fluctuate unpredictably, the entire surgical team must adjust, potentially affecting case scheduling, surgeon readiness, and overall operating room efficiency.

Automated bone processing systems address variability by delivering standardized, repeatable results regardless of who operates the equipment. In a comparative study, automated tissue removal consistently completed processing in 10 minutes with virtually no variation (± 0.06 minutes), while manual processing averaged 41 minutes with a stan-

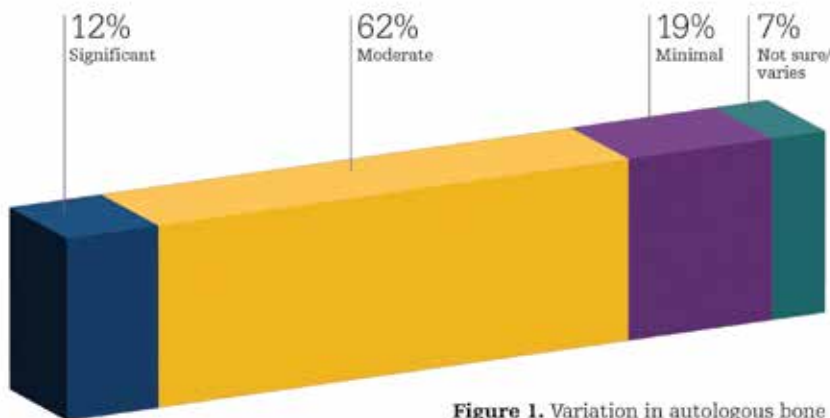


Figure 1. Variation in autologous bone graft preparation when different team members perform the task⁴ (N=42)

dard deviation of ± 23 minutes.⁴ This consistency allows surgeons to reliably plan for a known processing window rather than building in unpredictable buffer time.

Quality outcomes also become more predictable. When independent evaluators rated bone cleanliness on a 10-point scale, automated samples scored 15% higher on average than manually processed bone. Notably, 33% of manually cleaned samples scored below 4.8, indicating inconsistent quality that could affect graft performance.⁴

Among practitioners who have adopted an automated system, 87% report that it has reduced variability in their bone processing workflow (Figure 2).⁷ This aligns with broader research on operating room standardization, which has demonstrated that implementing standardized processes can reduce clinical variation.¹⁵

To achieve optimal results with automated bone processing systems, surgical technologists should follow manufacturer guidelines for bone loading quantities.

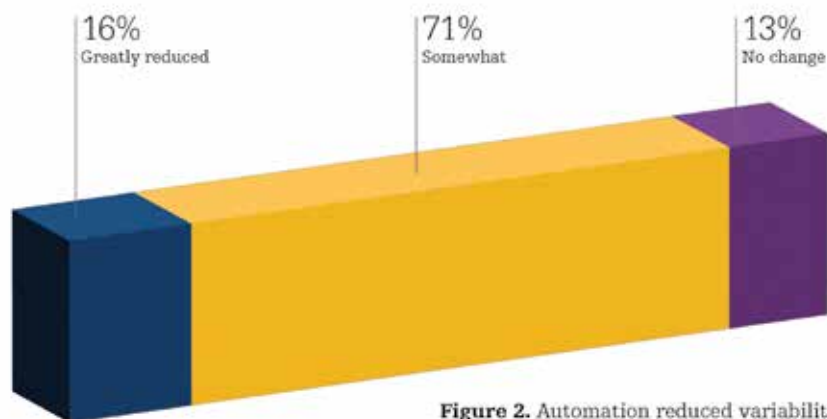


Figure 2. Automation reduced variability in bone graft preparation⁷ (N=38)

Automated tissue removal systems can process up to 25 grams of bone per cycle using a 10-minute run cycle. With a transparent cartridge design, the system can allow visual monitoring of the cleaning process without interrupting the cycle, and cleaned bone can then be milled in a single 8.4-second pass into the surgeon's specified particulate size.¹⁷

ACHIEVING PREDICTABLE, EFFICIENT PROCESSING TIMES

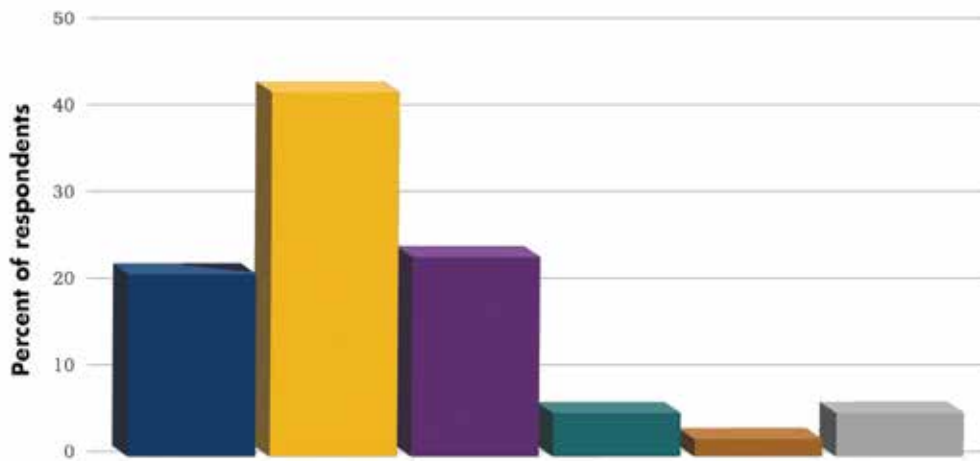
Efficiency in the operating room depends not only on surgical skill but also on the predictability of each procedural step. For surgical technologists responsible for autologous bone graft preparation, processing time variability presents a significant challenge to operating room scheduling, resource allocation, and team coordination.

Manual bone graft processing introduces significant time variability. Research shows manual bone cleaning requires an average of 27 minutes (± 14 minutes), with total manual processing time averaging 41 minutes (± 23 minutes).⁴ The survey of orthopedic spine surgeons and surgical technologists echoed this variability, with respondents reporting preparation times ranging from under 10 minutes (21%) to over 20 minutes (29%) (Figure 3).⁷

Automated processing systems can address these inefficiencies through standardized cycles. Automated tissue removal operates on a fixed 10-minute cycle with virtually no variation, while automated milling completes in seconds. This represents a 75% reduction in total processing time.⁴ This predictability has direct implications for surgical planning.

Unpredictable surgical duration poses significant scheduling challenges. Analysis of over 14,000 surgical cases found that 11 of 13 specialties systematically underestimated surgical times, with orthopedic procedures averaging almost 23 minutes longer than predicted.¹⁸ The Sermo survey findings reinforce this concern: nearly three-quarters of respondents reported moderate-to-significant variation in how grafts are prepared when different team members perform the task, yet

Figure 3. Self-Reported Time to Prepare Autologous Bone Graft® (N=42)



69% rated consistency as “extremely” or “very” important (Figure 1).⁷

Given that operating room time is valued at approximately \$46 per minute,⁵ even modest improvements in predictability yield substantial benefits. Research indicates standardized processes can reduce operating room time by 6-22% per case, which translates to a cost savings of 38.1%.¹⁹

These efficiency gains translate into tangible operational benefits. Reliable processing times enable more accurate case scheduling; optimized scheduling approaches can increase the percentage of surgeries starting within target windows from 28.65% to 32.13%.²⁰ Among the survey respondents with automation experience, 87% reported reduced variability, with 37% of surgical technologists noting better coordination with surgical timing (Figure 2).⁷ Predictable workflows also support better communication and role clarity. When processing times are consistent, teams can coordinate handoffs more effectively, which is particularly valuable during staff shortages when teams include rotating personnel.¹⁷

By reducing processing variability, standardized bone graft preparation enables more accurate surgical scheduling, better resource allocation, and enhanced team coordination – all of which support the surgical technologist’s essential role in delivering efficient patient care.

BEST PRACTICES FOR WORKSPACE SETUP AND TECHNIQUE

Surgical technologists face significant occupational health risks, with research showing they have among the highest rates of injuries and illnesses of all occupations.²¹ Studies of perioperative personnel reveal that 84% experience

lower back pain, 74% report shoulder problems, and 29% suffer hand-wrist disorders – conditions directly relevant to the repetitive manual tasks involved in bone graft processing.^{22,23} These concerns are reflected in the survey: one-third of surgical technologists identified physical strain and fatigue as a challenge during bone graft preparation, and 59% cited safety protocols and injury prevention as a priority training need.⁷

Thoughtful workspace organization and ergonomic technique can help mitigate these risks while improving efficiency. Three areas merit particular attention:

1. Workspace organization

Positioning the Mayo stand and back table within the surgical technologists’ immediate reach supports economy of motion and maintains focus on the sterile field during bone graft preparation. The Association of Surgical Technologists guidelines for establishing the sterile field recommend that furniture be positioned to minimize unnecessary movement while maintaining appropriate distances from non-sterile surfaces and high-traffic areas.⁹ Designating a specific area on the back table for the automated processing system and its components that is separate from other instrumentation helps prevent cross-contamination and supports efficient task completion. This intentional arrangement reduces the need to search for supplies mid-procedure and supports the parallel processing workflow that allows bone preparation to occur simultaneously with ongoing surgical tasks.

2. Ergonomic considerations

The American College of Surgeons emphasizes that poor ergonomics significantly increases musculoskeletal injury risk and impacts performance quality in the operating room.²⁴ When positioning equipment, it is crucial to maintain neutral body postures and avoid prolonged reaching, twisting, or static positions that contribute to fatigue during long cases. Automated bone processing eliminates the repetitive hand motions associated with manual cleaning and milling, which may cause hand fatigue in the majority of surgical technologists performing these tasks manually.⁴ Among the Sermo survey respondents, 33% of surgical technologists reported that automation reduced physical strain during graft preparation.⁷

3. Quality assessment technique

Before transferring processed bone to the surgical field, visually inspect the material through the transparent cartridge to verify adequate soft tissue removal and appropriate particle size. Research demonstrates that automated processing produces 15% higher cleanliness ratings compared to manual methods, with consistent results across users regardless of experience level.⁴ This standardization is particularly valuable in environments with rotating staff, as it reduces performance variability that can affect graft quality.

INTEGRATION INTO EXISTING WORKFLOWS

Successful bone graft preparation extends beyond individual technique to encompass how processes integrate within broader operating room workflows. Standardized protocols, clearly defined roles, and structured training enable consistent outcomes even when staffing varies. This is a critical consideration given ongoing workforce challenges in surgical settings.^{25,26}

Effective workflow integration requires adapting bone processing activities to specific procedural contexts while maintaining consistent execution standards. Research demonstrates that involving clinical stakeholders in workflow design and using simulation-based assessment before implementation improves team coordination and reduces handover times.^{27,28} This collaborative approach proves particularly valuable when integrating new equipment or protocols into established surgical routines.

Role clarity supports seamless integration. Survey data indicate that designating a specific team member responsible for graft preparation is a strategy employed by

approximately half of surgical teams, with surgeons showing particular emphasis on this approach.⁷ Formalizing such role assignments through standard work documentation helps ensure consistent execution regardless of which personnel are scrubbed for a given case.

Building on clearly defined roles, structured training programs build the foundation for reliable workflow integration across team members. Competency-based education approaches, including clearly defined performance expectations and milestone assessments, support consistent skill development.²⁹ Survey findings reinforce this priority: surgical technologists identify step-by-step processing techniques, time management and workflow coordination, and equipment setup and troubleshooting as key areas where additional training would improve preparedness.⁷

Mentorship extends initial training into ongoing professional development. Research identifies multiple domains where mentoring relationships benefit surgical personnel, including skill development, career guidance, and burnout prevention.³⁰ Senior surgical technologists play a valuable role in guiding less experienced colleagues through complex cases, helping translate standardized protocols into practical application.

Beyond initial training and mentorship, sustaining workflow optimization requires mechanisms for ongoing refinement. The Plan-Do-Study-Act cycle provides a structured framework for testing and implementing incremental improvements.³¹ Participation in quality improvement initiatives extends individual efforts into broader organizational learning.

Survey data suggest a perception gap regarding influence over workflow standardization: while many surgeons report that surgical technologist suggestions receive consideration, a substantial proportion of surgical technologists perceive their influence as limited.⁷ This difference highlights an opportunity for constructive engagement. Rather than relying solely on informal input, surgical technologists can leverage practical tools, such as setup checklists, timing documentation, and outcome tracking, to demonstrate the value of standardized approaches and contribute meaningfully to workflow reliability.

KEY TAKEAWAYS

Surgical technologists are central to efficient autologous bone graft preparation, with their contributions directly impacting surgical workflow, team coordination, and patient outcomes. The strategies presented in this article

provide a framework for optimizing this essential task amid ongoing workforce challenges and increasing procedural demands.

Several key principles can guide surgical technologists in enhancing their bone graft preparation practices:

Pre-operative planning and operating room setup

Effective bone graft preparation begins with thorough pre-operative planning. Strategic equipment positioning, such as placing automated systems on the back table or dedicated Mayo stand, minimizes unnecessary movement while maintaining surgeon accessibility. Systematic verification checklists and coordination during pre-operative briefings ensure equipment readiness and clarify anticipated bone volume requirements, enabling surgical technologists to plan processing workflow accordingly.

Consistency through standardization

With 74% of practitioners reporting moderate-to-significant variation when different team members perform bone graft preparation, standardization has become essential.⁷ Automated processing systems deliver consistent results regardless of operator experience level, reducing total processing time by 75% while producing cleanliness ratings 15% higher than manual methods.⁴ This predictability enables better surgical planning and supports integration of rotating staff. The need is evident: only 40% of surgical teams currently have clear timing protocols in place for bone graft preparation.⁷

Safety and ergonomic considerations

Research confirms that surgical technologists face significant occupational health risks, with studies showing hand fatigue affects virtually all technicians performing manual bone processing.⁴ Thoughtful workspace organization and ergonomic technique help mitigate physical strain, while automation eliminates the repetitive motions that contribute to musculoskeletal disorders.²⁴ Among survey respondents using automated systems, one-third reported reduced physical strain during graft preparation.⁷

Training and continuous improvement

Structured training, mentorship from experienced colleagues, and participation in quality improvement initiatives extend individual skill development into organizational learning. By documenting outcomes and demonstrating the value of standardized approaches, sur-

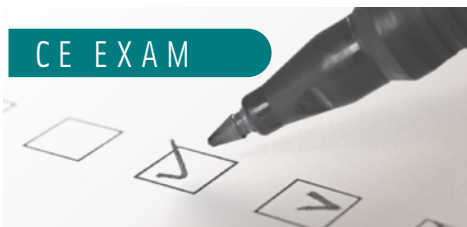
gical technologists contribute meaningfully to workflow reliability and continuous improvement in their facilities.

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1. Autologous bone is considered the "gold standard" graft material primarily because it:
 - a. is less expensive than allograft.
 - b. eliminates the need for sterile technique.
 - c. provides osteogenesis, osteoinduction, and osteoconduction.
 - d. requires no processing prior to implantation.
2. A key responsibility of the surgical technologist in autologous bone graft preparation is to:
 - a. perform the bone harvest incision.
 - b. remove residual connective tissue and mill bone into appropriate particle sizes.
 - c. interpret post-op imaging for fusion assessment.
 - d. select the fusion levels for the surgeon.
3. According to research cited in the article, how much time variability exists in manual bone cleaning compared to automated tissue removal?
 - a. Manual cleaning averages 27 minutes (± 14 minutes); automated processing takes 10 minutes (± 0.06 minutes)
 - b. Manual cleaning averages 15 minutes (± 5 minutes); automated processing takes 20 minutes (± 2 minutes)
 - c. Manual cleaning averages 10 minutes (± 2 minutes); automated processing takes 5 minutes (± 1 minute)
 - d. Manual and automated processing times are essentially equivalent
4. According to the Association of Surgical Technologists guidelines for establishing the sterile field, furniture should be positioned a minimum of how far from the wall and other non-sterile furniture/equipment?
 - a. 6 inches
 - b. 12 inches
 - c. 18 inches
 - d. 24 inches
5. Survey data revealed that surgical technologists identify which factor as a key efficiency strategy at notably higher rates than surgeons (44% vs. 7%)?
 - a. Designating a specific team member for graft preparation
 - b. Strategic equipment placement
 - c. Pre-operative briefing attendance
 - d. Using standardized checklists
6. Which pair of workflow obstacles did surgical technologists most commonly identify in the survey (each cited at 56%)?
 - a. Instrument shortages and surgeon preference variability
 - b. Limited sterile field space and coordination challenges
 - c. Power failures and irrigation supply issues
 - d. Lack of implant availability and poor lighting
7. What percentage of survey respondents reported experiencing moderate-to-significant variation in bone graft preparation outcomes when different team members performed the task?
 - a. 40%
 - b. 56%
 - c. 74%
 - d. 87%
8. The article states that operating room time costs approximately:
 - a. \$10 per minute.
 - b. \$25 per minute.
 - c. \$46 per minute.
 - d. \$100 per minute.
9. What percentage of survey respondents using automated bone processing systems reported reduced variability in their bone processing workflow?
 - a. 59%
 - b. 69%
 - c. 74%
 - d. 87%
10. For pre-op planning, the article notes that single-level lumbar fusions typically require approximately:
 - a. 1–5 cc processed bone graft.
 - b. 10–15 cc processed bone graft.
 - c. 20–25 cc processed bone graft.
 - d. 40–50 cc processed bone graft.

OPTIMIZING WORKFLOW: THE SURGICAL TECHNOLOGIST'S GUIDE TO EFFICIENT AUTOLOGOUS BONE GRAFT PREPARATION

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9	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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