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Chapter

Surgical Education: Focus on Gender Equality in Academic Surgery and Related Areas

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Abstract

Despite progress and advancements made to achieve gender equality, a glass ceiling still exists for women in surgery. Women remain largely underrepresented in academic surgery, with appointments to only 18% of surgery program director roles and 6.3% of surgical chair positions in the United States as of 2018. Inequities across various surgical subspecialties are also significant, especially in the areas of neurosurgery, orthopedic surgery, otolaryngology, and plastic and reconstructive surgery. Additional barriers exist for women in academics, including lack of high-quality female mentorship, implicit bias within letters of recommendation, and a greater incidence of reported moral injury and burn-out. Further efforts to address these inequities are necessary to retain the talents and contributions of women in surgery. Interventions that may counterbalance the continued gender gap within surgical fields include the implementation of implicit bias training, increasing institutional support, establishing formal mentorship initiatives, the introduction of early exposure programs during medical training, transparent institutional promotion policies, childcare support, and accommodation of maternity leave. The purpose of this chapter is to educate the reader regarding gender inequality in surgery and related fields and to highlight key issues central to the propagation of gender biases specifically as they relate to female surgeons across various roles and responsibilities (e.g., clinical practice, education/training, and leadership) within the contemporary academic landscape.

Keywords: academic surgery, equity and inclusion, gender equity, surgical education, women in academic medicine

1. Introduction

In 2019 women comprised about 52% of medical school graduates as compared to approximately 48% in 2009, which is a milestone for parity efforts in medicine [1]. Although medical school classes are roughly half female, women in surgery continue to be significantly underrepresented. For example, recent reports indicate that only 12.4% of active physicians and 29.1% of residents over five surgical fields (general surgery, plastic surgery, thoracic surgery, neurosurgery, and orthopedic surgery) were females [2–4]. Of note, this represents a slight improvement from

3. Women as surgeons

Existing research shows that there is a significant gender inequity in surgery [6] despite demonstrating that women are equally successful in their surgical residency training [7], and that operative performance and outcomes are not significantly different between men and women surgeons [7, 8]. Moreover, there is an increasing amount of evidence strongly suggesting that physician diversity benefits both the clinical team and patients [9, 10]. There are also important differences between men and women in regards to patient and team communication; research suggests that patients feel female surgeons are more likely to explain things with improved understanding, listen carefully, and spend sufficient time with them when compared to male surgical providers [11]. Despite such well-documented findings, gender disparity and biases continue within the surgical field. In the subsequent sections, we will explore some of the manifestations of gender disparities and bias, from subtle to overt, with a focus on potential actionable solutions and improvements.

4. Implicit bias in letters of recommendation and resident evaluations

Letters of Recommendation (LORs) are important components of the residency and fellowship application process. A survey examining the attitudes of surgical attendings and residents at the Mayo Clinic found that 73% of attendings and 82% of residents believed that LORs effectively stratify applicants into the upper and lower halves of candidates being considered [12]. LORs have been key in the ability to research implicit bias within the surgical field. In this context, implicit bias is the unconscious stereotype that is held against people or certain groups [13]. Though recent research shows an insignificant linguistic difference in LOR between male and female surgical applicants [14, 15], other studies support the existence of detectable inequality in letters written for male and female applicants [16–18]. More specifically, LORs written for women applicants are more likely to contain mentions of physical appearance [16], communal (teamwork, caring, and sympathetic), and caring themes [14, 18]. Moreover, the LORs were shorter for women than for their male counterparts [18]. LORs written in support of men had more mention of achievement and use of superlatives than their female counterparts [18]. For example, when LORs for transplant surgery fellowships were examined, those written for men contained more terminology highlighting competency and leadership [19], whereas females were more likely to be described with communal terms (e.g., friendly) [17]. The different tones, overall length, and word choice in LORs could represent a subtle manifestation of implicit bias, effectively making it more difficult for women to enter and advance within highly competitive fields [18, 20]. Since objective research clearly shows equal surgical skill across genders [7, 8], the observed linguistic disparity within the analyzed subset of LORs could be indicative of a broader issue of implicit bias in the historically male-dominated surgical field [21]. A summary of potential approaches to help address this problem is provided below:

- Use titles and surnames consistently for all candidates/applicants, with an effort made to objectively evaluate the final recommendation letter for the same
- Introduce established criteria for particular types of letters, and within this framework, focus specifically on the following criteria:

- Emphasis on professional activities, without editorializing
- Consistent focus on scholarship and professional productivity
- Maintaining an evidence-based approach and sharing of direct observations only
 - Emphasis on actual accomplishments and professional productivity
 - Ensure that various types of academic and professional contributions are clearly defined and treated accordingly
- Identify and evaluate accomplishments, as opposed to focusing on “effort”
- Maintaining an appropriate balance between interpersonal skills and other, more objective candidate characteristics
- When referring to stereotypically female traits, consider carefully if the characteristics are relevant within a particular context. Also, determine methodically whether other applicable characteristics or achievements may have been overlooked
- Avoid invoking stereotypical language, references to age, sex, disability, race, nationality, or religion. Each of these, despite being well-meaning, may invoke various degrees of reader bias
- Avoid providing personal information, including a review of the final written letter for such content
- For any particular type of letter, make every reasonable effort to ensure the approximately similar length and content quality for each applicant/candidate

(Source: https://gustavus.edu/committees/concertFiles/media/faculty_personnel_committee/KCEL_Strategies_to_Reduce_Bias_in_Recommendation_Letters.pdf)

5. Burnout: impact and gender differences

Burnout is a psychological phenomenon characterized by depersonalization, emotional exhaustion, and reduced personal accomplishment, which disproportionately impacts those in the medical field and leads to many downstream consequences, including suboptimal quality of care and decreased patient safety [22–24]. Reducing burnout in surgical residents is important not only for patient safety but also to retain precious and scarce talent in the surgical field. Of concern in this context is the finding that senior female residents are more likely to quit medicine entirely if they are dissatisfied with their job as compared to male counterparts [25]. Several risk factors for burnout have been identified such as female gender, diminished decisional autonomy, and decreased institutional support [24, 25]. A survey of 81 surgical residents found that 89.5% of university hospital residents and 95.2% of community teaching hospital residents had symptoms of burnout with female residents being 2.7 times more likely to have burnout and 2 times more likely to have suicidal thoughts [26]. In a survey of nearly 570 general surgery residents, women

reported higher rates of alcohol abuse, mental health concerns and diagnoses, sleep loss, and lower self-confidence than their male colleagues [27].

There are several phenotypes of burnout [28]: Depersonalization (e.g., viewing patients as impersonal objects; being callous and not caring about patient outcomes) is more common in men, while emotional exhaustion (e.g., fatigue; strained working with people; burnout from work) is more common in women [28]. It has been hypothesized that this difference may be explained by varying coping strategies. In addition, burnt-out female residents also reported experiencing greater amounts of gender discrimination as compared to their non-burnt out same-sex counterparts [28]. Recent research suggests that gender discrimination, decreased autonomy, and decreased resilience could each be contributing factors to the increased burnout experienced by female residents [26, 28, 29].

A prominent contributing factor to reduced autonomy is self-doubt. In a study of autonomy in the operating room among female residents, it was found that self-doubt caused them to project lower confidence in their abilities to operate, though each surgeon's actual ability was notably and objectively higher. In response to this projected lack of confidence, attendings subsequently reduced levels of autonomy in surgical residents, thus sending a message that they were not ready to or capable of operating. In turn, this process reinforced the female residents' unsubstantiated sense of self-doubt and decreased the opportunity to practice autonomously in the operating room [30]. Since transitioning out of surgical residency into an attending role is bolstered by increased operative experience and self-confidence, this cycle of reduced autonomy and reinforced self-doubt directly threatens a critical element of surgical residency training and the future careers of female surgeons. Moreover, this added cycle of self-doubt additionally contributes to burnout in female residents.

Important protective factors against burnout include resilience, program support [26, 28], and high-quality mentorship [31]. Resilience, in particular, is the ability to manage stress and work through adversity. Increased levels of resilience are influenced by personal achievement, family support, program support, and the male gender. Thus, burnout appears to be a multifactorial phenomenon with intrinsic and extrinsic factors that disproportionately impact female surgeons [26]. Awareness of the factors contributing to burnout and support provided on a personal and program level could help decrease or even prevent this phenomenon [26, 28].

6. Women in academic surgery

Although U.S. medical schools have been able to reach numerical gender parity, the same cannot be said about surgery as a specialty. More specifically, during the last 14 years, diversity in surgery has remained largely unchanged and predictions based on current trends suggest that at the level of surgical residency training, parity may not be reached until close to the year 2028, and the projected parity in female full professorship may not happen until 2096 [32, 33]. Research also suggests that while increases in female medical students and surgical residents appear to be similar, the rate of women rising to an academic leadership position is significantly lower when compared to their male counterparts. A study examining academic conferences determined that women conduct research of equal or greater quality than their male counterparts [34] but continue to be underrepresented at major academic fora (especially in leadership positions such as plenary speakers) proportional to the number of women in the field [35–38]. As of 2018, women only comprise 18% of surgery program directors [39] and 6.3% of surgical chairs in the United States [40]. Additionally, male surgeons are twice as likely to become

department chairs as compared to their female colleagues [41] and women are less likely to be recognized with tenure track positions [42]. Some barriers identified as important in this context include lack of effective mentorship and role models [42, 43], vague promotion expectations [44], social/cultural expectations [42, 44], and gender discrimination [43, 45, 46]. In the subsequent sections, we will address some of these key considerations with a focus on potential actionable solutions, real-world scenarios, and answers.

6.1 Mentorship in academic surgery

In a study reporting on interviews involving 15 mid-career and senior-level female academic surgeons, it was noted that essentially every participant emphasized that multiple mentorships were vital to their development in academic surgery [44], thus outlining the substantial impact mentorship provides on one's academic career and successes. Although mentorship is critical in the development of female academic leaders, a small survey out of Canada reported that women constituted only 11% of available surgical mentors, suggesting a significant deficit of female mentors with highly relevant experiential overlap [43]. Another study found that 63% of female faculty cited inadequate mentorship as a perceived reason why women are less likely to attain promotion [42]. There also appears to be a gender difference in terms of role models in academic surgery: 65% of men believed they had sufficient role models whereas only 38% of women felt they had access to role models in their field [42], further highlighting the critical need for the development of robust mentorship presence among women in academic surgery. The lack of mentorship and an insufficient number of role models for women in academic surgery could in itself contribute to the continually broken talent pipeline. The only viable solution in this context is to connect aspiring women leaders with suitable, high-quality academic role models and a variety of leadership mentors to the same extent available to their male counterparts.

6.2 Promotion in academic surgery

When female academic surgeons were interviewed regarding the perceived barriers to their career, many cited the fact that their institution had either absent or ambiguous criteria for promotion [44]. One large university hospital study found that the average time to promotion was 6.5 years for women compared to 5.2 years for men ($P < 0.05$), with women being remarkably less likely than men to be asked to serve in leadership roles (6% vs. 25%) [47]. Creating standardized subjective criteria for promotion has the possibility of leaving too much room for implicit bias, ultimately affecting promotion opportunities. Additionally, women have been found to take on the majority of family duties, including childcare and housework [47]. These competing responsibilities of home and work life may preclude women from devoting the essential and necessary time to achieve the milestones essential for academic promotion [47]. Of note, men have acknowledged that the advancement of their career is attributed to sacrifices made by their wives [48]. This could provide an explanation for why males are two times more likely to be promoted to department chair as compared to their female colleagues [41]. One study further suggests that women are more likely to leave academic surgery entirely due to sex discrimination, career dissatisfaction secondary to lack of opportunities for professional development, and networking difficulties from lack of mentorship, which further worsens the gap in promotions between women and men [44].

6.3 Social and cultural barriers in academic surgery

Efforts for equality have significantly changed the culture surrounding gender roles, although female surgeons continue to feel the effects of traditional roles and expectations. A survey of academic surgeons found that despite all participants reporting similar amounts of housework each week, women reported more than twice the amount of parental duties [42]. Of note, men were more likely to miss family activities due to competing work obligations, whereas women were more likely to miss work due to family obligations. The above observation could be associated with women receiving relatively less support from their spouses (78% of men and 67% of women), potentially due to their spouses being more likely to have full-time jobs (26% of men and 80% of women) [42]. One notable response from a female surgeon portrays this *status quo* eloquently, “Family responsibilities still end up—whether it is child-rearing or child-supporting or taking care of sick family members—it still tends to be in the domain of female surgeons” [44]. This heavy family burden could significantly contribute to burnout and thus make it more challenging for women to succeed in academic surgery and academic leadership.

6.4 Gender discrimination in academic surgery

The year 2021 marks the 185th anniversary of women in surgery in the United States [47], yet there still remains an obvious underrepresentation of women in academic surgery, especially in leadership positions [49]. Despite record numbers of women pursuing surgical careers, women continue to be at risk for gender discrimination and harassment in a historically male-dominated field [42, 43, 45, 46]. While women make up at least half of graduating medical students, a mere 12% of full-time professors in academic surgery are women, and there are only 28 female chairs leading Departments of Surgery across the United States [49]. Previous studies have outlined factors contributing to challenges and barriers affecting the advancement of female surgeons in academic leadership positions, including surgical culture, work-life balance, adequate mentorship, gender bias, sexual harassment, and approaches to promotions [49]. When asked, 48% of female surgical faculty believed that their career ambitions were not taken seriously by men [42]. Achieving professional milestones in academic surgery follows a process outlined by preceding surgeons, who historically, have been males. These standards fail to account for the timelines and additional priorities of female surgeons who balance significant responsibilities outside of work, such as caregiving and having fully employed spouses [50, 51]. Despite the discrimination and harassment experienced by female surgeons, longitudinal analysis showed that female surgeons who reported the highest amounts of sexual harassment were more likely to reach full professorship during a 17-year follow-up period, thus exposing deep-seeded issues in surgical leadership while demonstrating the resilience of women in academic medicine. Addressing academic medicine’s sex equity challenges requires identification that structural, institutional and cultural change is not just necessary, but required. Doing so involves creating new policies that differ from the current decades-old policies at institutional and national organization levels [50, 51].

7. Specialty specific considerations

As of 2019, general surgery led the surgical fields in percentages of practicing female physicians (approximately 42% of residents and 22% of attendings). At the other end of the spectrum, neurosurgery and orthopedic surgery had the smallest

percentage of women in the field (19.5% residents, 9.2% attendings and 16.0% residents, 5.8% attendings, respectively) [2–4]. Research also shows that the number of women entering surgical specialties is not sufficient to reach parity in the near future, and that in some surgical specialties, additional measures may be needed to increase workforce diversity [52]. Research generally maintains a greater incidence of sexual and emotional harassment, as well as discrimination directed at women within male-dominated fields [53]. This may be further compounded by a lack of mentorship and higher associated stress and anxiety levels [54].

7.1 Orthopedic surgery

Orthopedic surgery is traditionally a male-dominated field [2–4, 55]. There continue to be barriers to women entering orthopedics, despite research providing evidence that such status quo is not due to patient preferences, and thus presumably, more of a function of systemic issues within the specialty [56]. Issues related to female entry into orthopedics manifest early in medical training, with female medical students reporting negative perceptions about the discipline because of the lifestyle, male-dominated environment, and physical strength needed [57, 58]. The relative lack of exposure to orthopedics in medical school, combined with few female role models in orthopedics, could result in the persistence of associated negative perceptions. Fortunately, research shows that simple intervention consisting of even brief orthopedic surgery exposure could be sufficient to encourage female medical students to pursue a residency in orthopedics [59]. Of those medical students that participated in the initiative, 37% were matched into orthopedic surgery (as compared to the long-term baseline of approximately 16%) [3, 59].

7.2 Neurosurgery

Neurosurgical post-graduate education requires 7 years of training and the duty restrictions cap working hours at 80 per week for residents; however, there are no limitations on hours or intervals for attending neurosurgeons [60–62]. This demanding professional lifestyle is cited as a major barrier to gender parity, as well as an apparent deterring factor for medical students considering their surgical career choices [63, 64]. This, in turn, may contribute to the decreased retention rate of women in neurosurgery (83% female and 94.7% male retention) [63–65]. A study of Japanese female neurosurgeons found that more understanding of male leadership, combined with support for surgeons who wish to start a family could help enhance female retention rates [65]. Similar to orthopedic surgery, educational sessions for undergraduates and medical students have been offered to promote gender parity, and while they generally increase positive perception of the field, they also tend to increase concerns regarding the lifestyle of a typical neurosurgeon [64]. Consequently, the recruitment of medical students, and especially women into neurosurgery, is a much more complex area of discussion and controversy. Important pillars toward more equitable recruitment may include integration of mentorship promotion, baseline undergraduate education, early research exposure, considering student needs, providing educational resources, addressing financial concerns, and fighting the phenomenon of “neurophobia” (e.g., perceived difficulty attributed to the field of neurosurgery) [66].

7.3 Other surgical and procedural subspecialties

Although our discussion thus far has focused on general surgery, orthopedics, and neurosurgery, similar observations have been noted across a number of surgical subspecialties. According to recent data, issues related to equal gender participation

are prevalent across many other procedural and operative specialties. For example, about 16% of practicing otolaryngologists (ENTs) in the U.S. are women [67, 68]. Furthermore, female ENT surgeons tend to receive lower compensation, perform more unpaid and unrecognized work, and similar to other fields, are more likely to be subject to harassment [68].

Plastic and reconstructive surgery (PRS) has also been documented to have unequal treatment of women [69]. The “leaky pipeline” is a metaphor commonly used to describe the progressive decline in the number of women at each subsequent step of the professional ladder. This has been noted in PRS as well, despite the fact that women are more represented here as compared to other surgical specialties [70]. Similar to ENT, female plastic surgeons are less likely to advance in rank, societal board membership, invited speaker opportunities, and compensation [70]. Nevertheless, the field of PRS may be making strides toward transformation, with recent evidence of greater female presence at educational meetings, including podium presentations, publications, panelists, and moderator roles, as well as invited speakers [71, 72]. Additional surgical and medical subspecialties, including oromaxillofacial surgery, gastroenterology, obstetrics and gynecology, and urology report similar gender biases and challenges for women [73–85].

8. Pregnancy and maternity leave: residency and attending practice perspectives

Traditionally, pregnancy was considered controversial during surgical residency [86, 87]. A resident’s commitment to the field may become questioned, along with colleagues becoming frustrated about the prospect and reality of having to deal with the added responsibilities that are created by a resident’s absence after childbirth [88]. Based on one author’s personal experiences and observations of nonverbal reactions to her pregnancy of her peers, as well as no discussions to create accommodations in work/operating schedule during the last trimester of pregnancy to ensure the safety of herself and her unborn baby, she felt pregnancy during residency created additional mental and physical challenges to those already experienced by female surgical residents [88].

The ability for women to have children during residency has become more common, more supported, and much more accepted during the past decade. That said, more than half of women choose to wait until after residency to start a family [89], and are more likely to delay having a child until after training when compared to their male counterparts [90]. While childbearing in residency is becoming more common, women continue to fear the stigma of appearing weak, are concerned that working during the third trimester may cause risk to fetal health, and must be conscious of the lack of lactation support available at the workplace [88].

A study of pregnant orthopedic residents may give basis to their health concerns; orthopedic surgeons were two times more likely to experience pregnancy complications than a reference population when controlled for race, age, health, and socioeconomic status [91]. Research shows 85.6% of women work with an unmodified work schedule until they go into labor [92]. Moreover, working 60 or more hours per week was associated with increased pregnancy complications [91]. It is further suggested that current culture and policies around maternity leave may indeed be harmful to maternal and fetal health. Though policies are mandated, they are not often enforced; for example, the ACGME mandated that residency programs need private rooms for lactation [58]; however, few programs have been found to meet these requirements [93].

As of 2017, only slightly more than 1/3 of female surgical residents reported that their program had formal maternity leave policies with 78.4% of women taking

6 weeks or less of maternity leave [91]. As of the 2019–2020 academic year, new policies from the American Board of Surgery (ABS) allow for two additional weeks off from years 1–3 and in the last 2 years of residency for family leave with hopes of being more accommodating to women in surgery [94]. In addition to maternity leave, securing childcare is a challenge for female surgeons [44, 88]; 75% of female medical students agreed they would be more interested in surgery if there was childcare on-site [95] and 75.4% of residents thought childcare support would help them in their training [91]. In summary, to make surgery a more accepting space for women, it is important to enhance lactation support, childcare support, life-work mentorship, and also create more accommodating maternity leave policies.

Choosing to breastfeed as a mother is itself a substantial time commitment and requires adherence to maternal nutrition and a pumping schedule to ensure adequate milk supply for the baby. The grueling schedule of surgical residency, lack of support from administration and co-residents, and decreased resources such as a dedicated lactation area all lead to discouragement toward breastfeeding, an inability to maintain milk supply, and early termination of breastfeeding. In a recent study highlighting lactation challenges of resident physicians [96], the median duration of providing breast milk was 9 months. Only 21% of residents reported access to usable lactation rooms within their training hospital. Breast milk storage was an issue for 60% of lactating trainees, with 37% of the residents reporting unplanned and/or premature termination of lactation. Statements of faculty and co-residents created guilt, reported by 40% of lactating residents. Small changes in these areas can lead to big impacts on the mental health and ability of the post-partum resident to feel supported, and, in turn, perform at the workplace while being able to provide for her family at home.

9. Medical student perspective

Women enter medical school with relatively less interest in surgery when compared to other fields, are less likely to develop a new interest in the field, and are more likely to lose interest in surgery over time [95, 97, 98]. Exposure and recruitment across male-dominated specialties during medical school may help increase our ability to attract female medical students into these fields [99, 100]. Research has shown that it would be beneficial to expose medical students to surgery in their preclinical and clinical years to dispel negative perceptions of the field [97, 101]. Mentorship during the preclinical years is also associated with increased interest [102, 103], confidence, clerkship performance, and retention in surgical fields [104]. Although women tend to receive less technical experience in surgical training when compared to their male counterparts, they do report the same degree of enjoyment and interest in performing surgical procedures. Additionally, women tend to be less confident [99, 105] and underestimate their skills when compared to their male counterparts [106]. All of these factors could contribute to female medical students avoiding surgical specialties. Early interventions to facilitate mentorship and increase exposure could help recruit female medical students into the surgical field.

10. Mentorship

Mentorship is proven to be both crucial and beneficial for personal and professional development in surgery. From work-life balance to career advice, mentorship has many positive effects, such as increasing confidence [107], reducing burnout [31], and increasing interest in surgical fields [102, 103, 107]. In fact, a recent study showed that organizational support and mentorship were the two most important

factors determining if women pursue a career in surgery [108]. With the absence of such mentorship and seeing few to no other women colleagues, female residents can develop the so-called “imposter syndrome” (e.g., feelings of self-doubt and personal incompetence). This reiterates the importance of early same-sex role models and mentorship and how beneficial such initiatives are to women pursuing a career in surgery [108, 109]. One author worked with a female surgical mentor early in her career. This mentor was a well-respected surgeon who was also able to balance her home and family life. Seeing this was one of the top contributing factors that encouraged the author to pursue a career in surgery and to dispel thoughts of imposter syndrome. Finally, mentorship is traditionally characterized as a long-standing one-on-one relationship where the mentee relies on their mentor for guidance on a variety of topics; however, the so-called MOSAIC (see next section) mentorship approach may be more beneficial for female surgeons [109].

11. The MOSAIC model: mentoring of surgeons across identity and culture

Mosaic mentorship can take many different forms, such as a formal or informal relationship “to match specific, short-term personal or career goals” [109, 110]. Aside from one-on-one mentoring, there is also group mentoring, where one mentor takes on multiple mentees, and mentoring committees, providing a MOSAIC (Mentoring of Surgeons across Identity and Culture) approach. The use of MOSAIC allows multiple mentors (in different fields or subspecialties, across various regions or countries, and of different ethnicities and sexes) to influence the development of a surgeon. The Coronavirus Disease 2019 (COVID-19) pandemic has influenced the use of virtual methods which makes the use of long-distance mentorship more accepted and necessary [111]. No matter what form or combination of forms is chosen for or by the mentee, there is a predictable structure to mentoring. There are four phases to this relationship, regardless of the method chosen: preparation, negotiation, enabling growth, and coming to closure [112]. In preparation for MOSAIC implementation, there must be initial meetings, the setting of appropriate expectations, and discovery of motivations. During the negotiation phase, content, goals, and processes, such as the rules, parameters, and confidentiality procedures should be discussed. The enabling phase is where all the hard work occurs; this is a time for candor and constructive feedback. Finally, the closure aspect may occur earlier than expected, or it may go on for years. Whenever it occurs, it should take place on a positive note, where the positive / constructive aspects of the relationship are highlighted and celebrated.

Upon interview of individuals, academic faculty members identified altruism, honesty, active listening, and professional experience as the most important mentor qualities, whereas time and accessibility were the biggest challenges to mentorship according to their collective experience [113]. In light of the COVID-19 pandemic, many worried that surgical mentorship would suffer because of remote work; however recent research shows that online mentorship is possible and has positive results [113]. Perhaps this could be used in the future to connect female medical students and residents to same-sex mentors across long distances to encourage interest in surgery and career development.

12. Synthesis and conclusions

In summary, gender disparities are still prevalent in surgery, especially in orthopedic and neurosurgery. Major themes in recent research contributing to surgical gender barriers include gender discrimination, implicit bias, burnout, lack of

mentorship and exposure, vague promotion and tenure criteria, and social/cultural expectations. Specific interventions include mandating implicit bias training, increasing institutional support, establishing formal mentorship initiatives, implementation of early exposure programs during medical training, clear institutional promotion policies, childcare support, and accommodation of maternity leave. It is the authors' hope that with these interventions, healthcare teams can become more diverse and inclusive, having positive impacts on patients and healthcare workers alike.

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