



Cleft Lip and Palate Repair Training to Bridge the Gap in Low-Income Countries

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Introduction: There is a significant unmet need for cleft repair in low-income countries. The procedure is challenging due to limited access, small fragile flaps, and the depth at which sutures need to be placed. The aim of this analysis is to review available literature pertaining to cleft lip and palate repair training, with a focus on those applicable to low-income countries.

Methodology: Literature searches of Medline and EMBase were performed to identify studies of cleft lip and/or palate training. Terms including “cleft,” “lip,” “palate,” and “training” were searched. Literature published in English from inception to May 2021 in which the full text was available was considered for inclusion. Studies were included on the basis that they included interventions such as virtual/online training, simulation training, courses, fellowships, and/or hospital-based training. Studies that met this criterion were further assessed using a validated scoring tool then the applicability of each training strategy for low-income countries reviewed.

Results: Nineteen studies were included in this analysis. Of these 4 studies pertained to online training, 11 studies illustrated cleft models and simulation training, while 4 studies highlighted the role of charity led training achieved through direct hospital teaching and fellowship programs. The training strategies described have been summarised and presented herein in a

narrative format. The simplicity, fidelity, and training benefit of palatoplasty models has also been described.

Conclusions: Cleft lip and palate repair training should be accessible to surgeons in low-income countries. Direct practical experience has an important role in training to perform cleft procedures. Affordable, simple simulation models that resemble human tissue are essential so that surgeons can safely practice skills between initial training and operating on a living child.

Key Words: Cleft, cleft lip, cleft palate, low-income countries, medical education, training

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Cleft lip and palate, also known as orofacial clefts, are common birth defects of varying severity and presentation.¹ The formation of the lip and palate depends on the correct growth, maturation, and fusion of the 5 facial prominences, occurring between the fourth and twelfth weeks of gestation. Due to its complexity, errors in development of the cleft lip and palate are common with an incidence of approximately 1.7 per 1000 births.² The severity of the anomaly is related to when the error occurs. Early errors result in more deformity whereas later errors can be as relatively simple as a cleft lip. The etiology behind failure of palatogenesis is multifactorial and often present as part of established syndromes or due to teratogenic effects. There also appears to be significant variation dependent factors such as geographical location and ethnic background.³

In the Western world, such abnormalities are readily corrected with surgical intervention and so, it is rare to see such a deformity by school years. However, in developing countries this is not true. In low-income countries emergency and other life-saving procedures often take precedent. Furthermore, there may not be surgical personnel, speech and language therapists, and other resources available to correct cleft lip and palate. As a result, cleft lip and palate often goes uncorrected. As the location of the deformity is not easily disguised such children are often ostracised by their community,⁴ who may associate the deformity to notions such as “acts of God,” “witchcraft,” or “black magic.”^{5,6} Children may also isolate themselves as coping mechanisms.⁶ Since a cleft will not resolve without surgical intervention, such stigma, where present, will thus be for life.

At present, surgery required to correct the defect is restricted to high-income countries.⁷ As a result, the incidence of cleft lip and palate is greater in developing nations. Approximately 9 out of 10 people in low-income countries do not have access to basic surgical care.⁸ Though cleft lip and palate repair is relatively inexpensive (\$250),⁹ the procedure is not often performed by surgeons native to low-income countries.¹⁰ As a global community of Plastic and Reconstructive surgeons there is a movement to support those in developing countries. Surgeons and medical personnel with charity organizations such as

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For this systematic review, ethical approval was not required.

For this type of study, consent from patients was not required.

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Operation Smile, BFIRST, and Facing The World travel to hospitals with limited resources and personnel, providing cleft lip and palate procedures and training to local surgeons.¹¹ However, surgeons with charity organizations are only present in resource-limited hospitals for a short period of time. As a result, the training received by local medical personnel is limited. There is, therefore, a need to increase the training provided. In doing so, local surgeons will be able to provide cleft lip and palate care for their community. This would eventually allow such nations to become self-dependent with regards to the knowledge and expertise required to carry out cleft lip and palate procedures, as well as then being able to train their own surgeons without the need for further external input.

Ideally, all nations would have programs in place to train local surgeons. However, barriers to this include the cost of training itself. In the United Kingdom, trainees inevitably spend between £20,000 and £26,000 to expand their knowledge and expertise in Plastic and Reconstructive Surgery.¹² In resource strapped nations such an amount is simply unobtainable, where access to and standards of care have stagnated or even regressed.¹³ Supplies that a surgeon in a developed country for granted such as water, electricity, or even surgical gloves are often lacking in low income countries.

There is therefore a need for low-cost reproducible training. One such method is by providing virtual and distant learning from expert surgeons to trainees. However, distant teaching alone will not prepare a surgeon to adequately perform a surgery. Simulation is a training strategy gaining increasing popularity. It enables consolidation of anatomy, core steps in the surgery, and practice without harm to a patient. By incorporating virtual teaching with simulation, trainees in low-income countries can better prepare to operate. Together with hospital visits to and from expert surgeons, this combination of training techniques can provide a means to prepare surgeons for cleft lip and palate. In low-income countries, the ideal cleft lip and palate model is low cost, easily reproducible, and of high fidelity. This review aims to evaluate existing training strategies for cleft lip and palate repair, with a focus on those appropriate to trainees in low-income countries.

METHODOLOGIES

Search Strategy

Analysis was initiated with a search of literature published from inception to July 2021 using the online databases Medline and EMBase with the mesh terms; “training,” “teaching,” “education,” and “cleft” (Supplementary Digital Content, File 1, <http://links.lww.com/SCS/D646>). Medical literature identified by this search strategy was listed using a Microsoft Excel 2015 database.

Inclusion and Exclusion of Literature

Two reviewers were each provided with a study selection form to be used for assessment of literature for inclusion or exclusion in this review (Supplementary Digital Content, File 2, <http://links.lww.com/SCS/D647>). Reviewers independently evaluated literature. Where reviewers disagreed on literature for study inclusion, this was resolved by discussion with the other reviewer and the senior author. The titles and abstracts of search findings were collected to exclude duplicate findings. Literature with no relation to cleft lip or palate repair training was excluded.

Literature Evaluation

Full copies of all included literature were retrieved for further evaluation. Critical appraisal of all studies was performed using the Critical Appraisal (Critical Appraisal Skills Programme) tools.¹⁴ Studies were categorized according to the type of training provided: online, lecture, course, simulation, fellowship, and clinical hospital training. After completing the critical appraisal, an Educational Utility Score was assigned to each study. This was achieved by using the following validated scoring tools; The BestBETs Checklist for Reviews and Meta-analyses¹⁵ and The Cochrane Risk of Bias tool.¹⁶ A maximum of fifty points were available through The BestBETs Checklist and Cochrane Risk of Bias tool. Studies were also awarded a score (maximum 10 points) for relevance of the manuscript to the study in question. The full scoring used to assess literature is detailed in Supplementary Digital Content, File 3, <http://links.lww.com/SCS/D648>. Generating these scores enabled direct comparison between the educational interventions evaluated.

CLEFT LIP AND PALATE REPAIR – TRAINING STRATEGIES

Barriers to providing cleft lip and palate care in low-income countries include a shortage of trained specialists as well as limited resources. Humanitarian trips and partnership programs between low- and high-income hospitals are essential to provide initial training of local surgeons, enabling a continuity of surgical care that lasts well beyond the mission trip. Where such trips are not feasible, global web meetings,¹⁷ live surgery viewings,¹⁸ and remote mentoring¹⁸ are also beneficial to the training of surgeons in low-income countries.

Training strategies designed for implementation in low-income countries aim to maximize the resulting health benefit while minimizing the associated cost-expenditure. Virtual reality and other animation-based simulation programs are a highly cost-effective means of sharing knowledge in plastic surgical procedures across the globe. Plana et al,¹⁹ and Culnan et al²⁰ reported a total of 849 users from 78 countries within 1 year of introducing the online cleft simulator while Kantar et al²¹ demonstrated that this increased to over 4000 users from 136 countries within 5 years of introducing the simulator. Plana et al²² considered the efficacy of this online simulator by comparing it to traditional textbook learning. Participants were asked to draw the marks for a standard cleft lip repair before and after 20 minutes of study using either the online simulator or a textbook. Assessment of the accuracy of these markings demonstrated greater improvements in the group using the simulator, supporting its use by novice learners. Tanaka et al²³ designed high quality 3-dimensional patient models that take less than 100 kilobytes. Compared with models of the same quality but in Virtual Reality Modeling Language format (require over 5 megabytes) the tool designed by Tanaka et al²⁴ is able to provide high quality teaching even where there are low-band-width networks, as in many Low income country and remote areas.

Online resources do not provide the hands-on practice. Simulation models are an excellent way to bridge the gap from understanding to performing surgical procedures in live patients. They provide the opportunity to develop and improve the key technical skills required to work in the small narrow oral cavity during cleft surgery. This includes; practicing incisions and dissection at awkward angles, practicing sutures at depth, working in a narrow surgical field, and delicate tissue handling. Such models are especially important for cleft surgery training as cadaveric models are virtually nonexistent. To be of use in

low-income countries, simulation models should be realistic and affordable. Both high-fidelity²⁴⁻²⁶ and more resourceful cleft lip and palate models²⁷⁻³³ have been reported (Supplementary Digital Content, File 5, <http://links.lww.com/SCS/D650>).

Nagy et al,³⁰ Vadodaria et al,³¹ Pappachan et al,³² and Matthews et al³³ incorporated latex with other readily available materials to create palatoplasty models. The remaining studies also used economical materials to create a simulation model; Pinho et al²⁸ used plastic cups with ethylene-vinyl acetate, a straw, fabric, and a maxillary dental cast. Senturk et al²⁹ used a double sheet of sponge within a cut plastic bottle. Meanwhile, Cote et al²⁷ used silicone and rubber casting to create their educational model. In all cases, the authors concluded that the cost-effectiveness and acceptable tissue likeness makes these simulation models a very useful hands-on tool to practice palate repair. These models may be of particular benefit in workshop settings, incorporating teaching from experts with experiential learning. Three studies explored the benefit of simulation-based workshops for the training in cleft procedures.^{21,25,26}

Cheng et al²⁵ and Podolsky et al²⁶ used cleft palate simulators to teach workshop attendees how to perform von Langenbeck palatoplasty. In both cases, workshops were conducted in high-income countries (the US²¹ and Canada,²⁷ respectively) and authors concluded that the cleft simulators used are a realistic and valuable training tool. The value of simulation-based workshops was similarly demonstrated by Kantar et al²⁴ who organized a 3-day cleft-care workshop in Beirut to provide an opportunity for training Plastic Surgeons to practice cleft lip and palate repairs. The high level of satisfaction reported by workshop attendees mirrors the feedback in high-income countries by Cheng et al²⁵ and Podolsky et al.²⁶ A combination of affordable training models with teaching from experts through workshops could therefore be a highly effective way to prepare plastic surgery trainees worldwide to perform cleft procedure on live patients.

When surgical trainees transition to operating on real patients this should involve senior experts to prevent patient harm and optimize outcomes. Senior expertise can be obtained during mission trips and fellowships. Louis et al³⁴ and McCullough et al³⁵ explored the educational benefit to LIC-based trainees as a result of training from experts provided during humanitarian trips organized by Smile Train³⁴ and Operation smile.³⁵ In both studies, collaboration between high and low-income countries enabled LIC-based surgeons to learn how to perform cleft procedures, improving their knowledge of the procedure and technical skill. Yao et al³⁶ and Campbell et al³⁷ also investigated the benefit of the Operation Smile Regan Fellowship and Stryker International Fellows program to plastic surgery residents from LICs and developed countries. These studies incorporated the responses of a total of 186 plastic surgery residents who completed this fellowship – all reported the fellowship was a valuable educational tool.

Optimizing Training in Low-Income Countries

Critical appraisal of literature included is demonstrated in Supplementary Digital Content, File 4, <http://links.lww.com/SCS/D649>.

The existing training strategies for cleft lip and palate surgical repair are summarised in Supplementary Digital Content, File 5, <http://links.lww.com/SCS/D650>. Comparison of Educational Utility Scores reveals higher scores in studies involving high-fidelity training models. Scores are particularly high where there is also a workshop component provided. This suggests that a practical approach including both active teaching and hands-on practice may be the optimal training. Though high-fidelity models may be preferred by surgical trainees, the

cost and resources involved must be considered when planning training for low-income countries. Though excellent teaching resources, the models described by Cheng et al²⁵ and Podolsky et al²⁶ may be too expensive for use in low-income countries. Similarly, though the production of the models described by Cote et al²⁷ was relatively cost, this involved 3D printers which will not be readily accessible in low-income countries. Ultimately, training in low-income countries can be optimized by providing as high-fidelity models as possible, within the budget available, and combining the use of these models with virtual training, and teaching from senior surgeons.

Review Strengths and Scope for Future Work

At the time of this writing, available cleft lip and palate repair training approaches have been explored and their benefit to surgeons in low-income countries evaluated. The simulation models, courses, and fellowships discussed can be used together to supplement training. Review of low-cost simulation models and on-line/virtual reality resources provides readers the option to trial and incorporate these into ongoing or developing programs, thereby providing trainees an opportunity to practice skills before progressing to operating on live patients. A training program can be designed using existing curricula from developed countries, considering the Accreditation Council for Graduate Medical Education requirements to ensure that the resulting training is of an adequate standard, and applying this curriculum to the local needs.

Future work could include designing modules in training to manage cleft lip and palate in low-income countries, and trialing these in a cohort of trainees. Evaluation of the pre- and post-module knowledge would confirm the educational and humanitarian value of such modules.

CONCLUSIONS

Developing a community of cleft surgeons in low-income countries requires global collaboration between surgeons in high- and low-income countries, as well as resources and support from charities. By providing teaching, guidance, personnel, and equipment, cleft lip and palate can be taught worldwide, providing a means to safe surgical care across the globe.

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