Brief Report

Better Wielding the Electric Drill

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Abstract

one is a dense, mineral-rich tissue with organic components. Implants such as plates and nails are used to reconstruct fractures. Various types of drills are used in orthopedic surgery, ranging from pneumatic and battery-operated to electric devices, each of which has its own set of benefits and drawbacks.

Standard care is generally achievable through orthopedic battery-operated and pneumatic drills, which are costly and have high maintenance costs. So, orthopedic surgeons frequently employ alternatives such as the Bosch battery drill, and a corded electric drill is generally used in developing nations. These drills are inexpensive, but they cannot be used for reaming. Furthermore, some models of these drills have a constant speed, making them difficult to be utilized for reaming.

We offered modifications to this type of drill to control its speed, so it can be used for reaming. There is abundant evidence dismissing misconceptions such as electric drills' overheating and subsequently leading to bone thermal necrosis. There are multiple scientifically documented methods to effectively sterilize an electric drill. Due to its affordability and ease of maintenance, our innovations, such as speed control and drill cannulation, enable us to adopt this device for most traumatic surgeries, particularly in developing nations.

Keywords: Electric Drill, Reaming, Battery Drill, Bosch

1. Background

Bone is a dense tissue constituting minerals and organic components. The repair of a fracture necessitates employing implants such as plates and nails. These procedures involve drilling into the bone, which produces two forces: thrust and cutting. The thrust force acts in the opposite direction of the drilling and is related to the type of bone being drilled. The cortical bone, for example, generates a greater thrust force than the cancellous bone. On the other hand, drilling speed, torque, and the diameter of the drill bit all influence the size of the cutting force placed on the bit's cutting edge.

A wide array of drills ranging from pneumatic and battery-operated to electric drills are utilized in orthopedic surgery. Every type of drill has its unique set of advantages and disadvantages. Because of its benefits, most trauma surgeons in the developing world prefer the electric drill. The pros include cost-effectiveness, ease of use, and reusability, and the cons are restricted drilling capability, inability to be used for reaming, having a constant speed, and being non-autoclavable (1).

2. Technical Notes

The prototype of the drill used by us is provided by a local manufacturer (Figure 1). The handpiece is wholly made of plastic, while the initial part of the body, which was meant for chuck attachment, is made of iron. We replaced the original Jacobson chuck with stainless steel coupled to hold the reamer for nailing. The initial iron chuck was replaced with a stainless-steel chuck. There were three reasons for this: (1) We had to modify the chuck to fit in the coupling, (2) The chuck could be autoclaved after being detached from the drill, and (3) The steel chuck is resistant to corrosion, which is important as constant exposure to blood and water during surgery causes the original iron chuck to be corroded, increasing the chances of infections. This chuck was equipped with three jaws that securely grasped the drill's bit or K wire, which could be opened and closed with a key. The ergonomically built handpiece features a cord as the power supply. We increased the power cable's length to seven meters to keep it out of reach of anesthesia equipment and oxygen cylinder. The original drill had a constant speed, but we modified the speed control using a knob to alter the pace depending on its utilization for drilling holes in either bone or ream.

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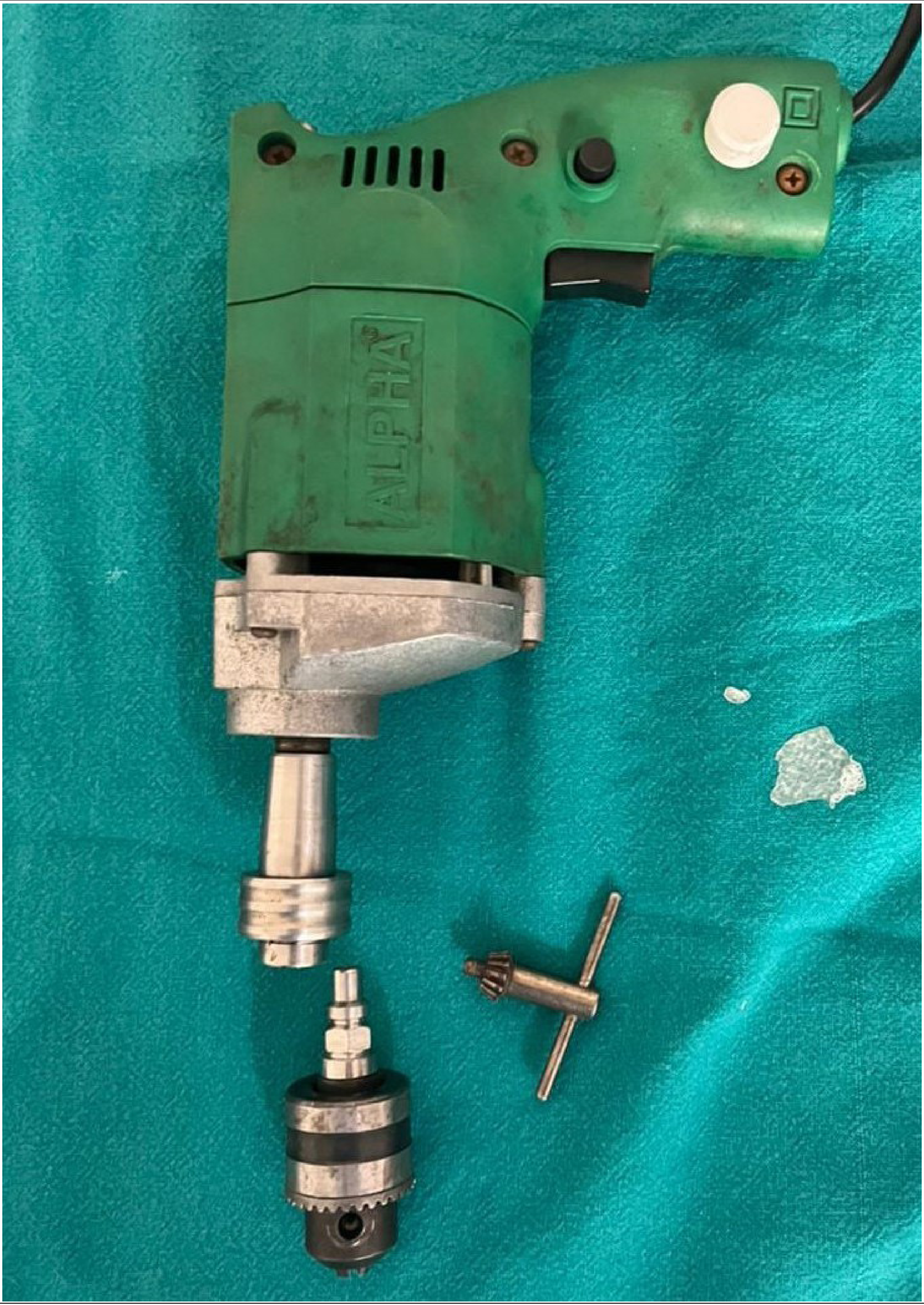

Figure 1. The drill with detachable chuck, speed controller, and cannulated system.

To maintain the drill's sterility, we placed the drill in a formalin chamber and autoclaved the detachable chuck. In addition to the above-noted modifications, the drill was cannulated to allow the guidewire to pass through while reaming. Alternatively, we used ethylene oxide (EtO) to sterilize the drill. The drill was removed from the box and covered with a sterile sheet and bandage (Figure 2). Following surgery, the sheet is removed, and any blood is cleaned from the surface with alcohol and hydrogen peroxide. We can also use a camera cover in arthroscopy or a stockinet to cover the drill or make one permanent drill cover with a cloth, so it can be autoclaved every time before being used. After the complete opening and closing of the jaws, special care is taken to clean the mouthpiece. The entire drill is cleaned with a spirit or an alcohol-based compound before reinsertion into the formalin chamber. We successfully used the altered electric drill to perform interlocking nail placement in the tibia and femur in many patients (Figure 3).

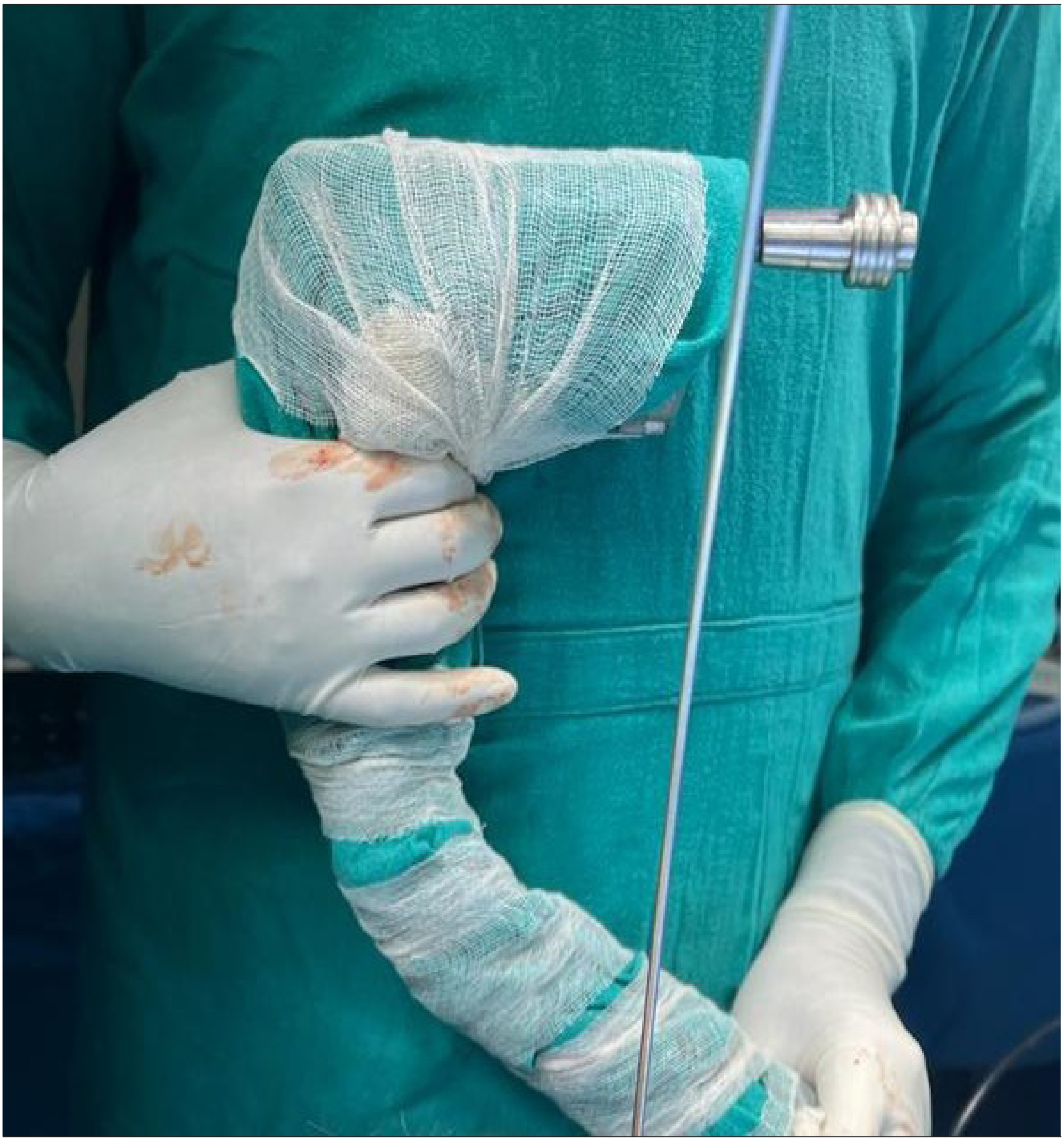

Figure 2. Drill draped in drapes and secured with an autoclaved cotton bandage.

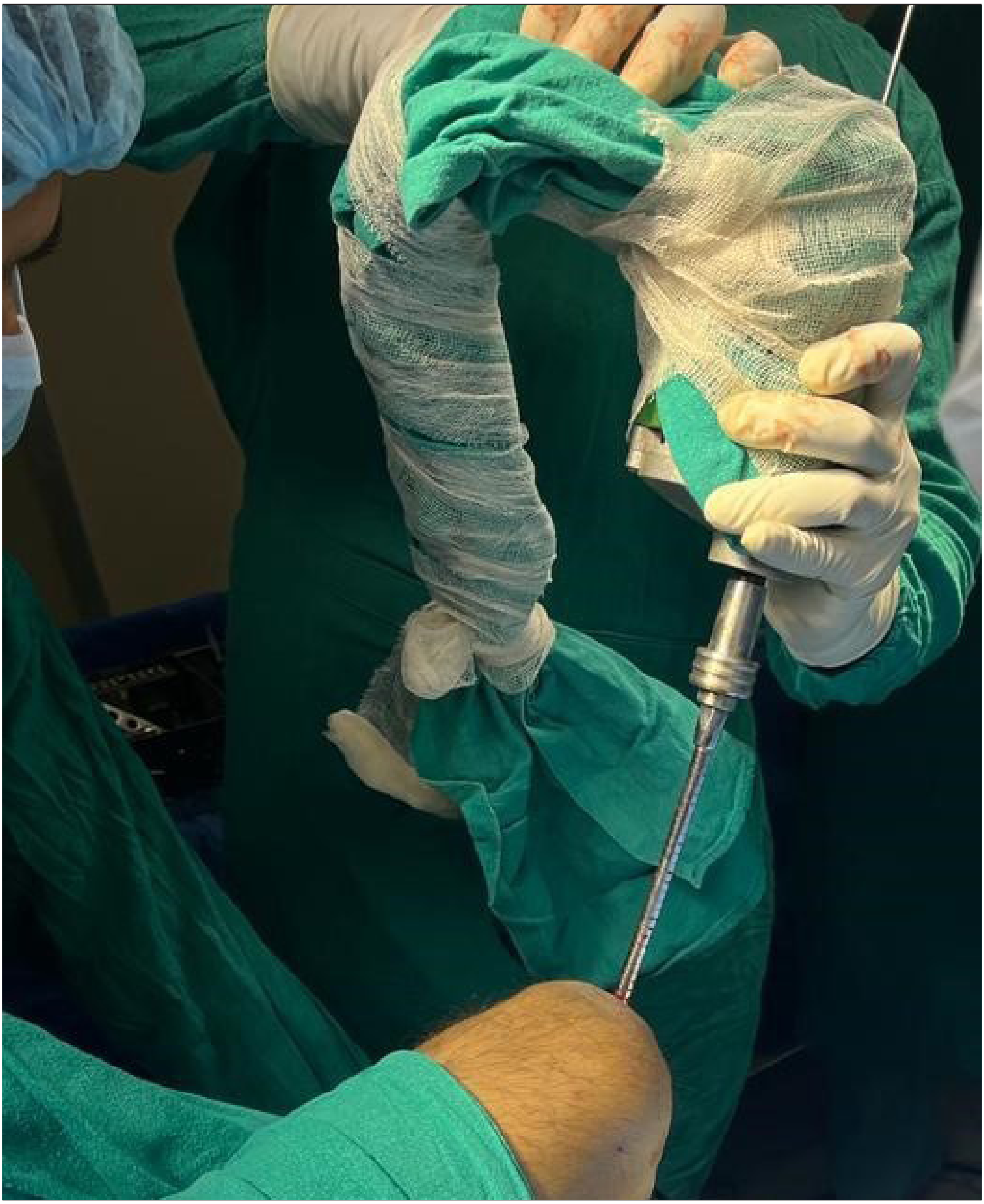

Figure 3. Reaming of the Tibial canal with flexible reamer and using an electric drill due to cannulation.

3. Discussion

While the pneumatic drill system (PDS) and the orthopedic battery drill (OBD) are employed in orthopedic practice, their costs are incredibly high. The PDS is equipped with a robust hose, restricting the surgeon's mobility when targeting screws at an angle. The primary advantage of a battery drill is the freedom of maneuvering in desired directions without the need for using a hose or cable. The downside of battery drills is that the drill's 12V battery must be charged for 25 to 240 minutes before usage. The batteries must be replaced between surgeries, increasing operation time and jeopardizing sterilization. Another issue with the drill's battery is that its torque decreases as the battery charge depletes.

An electric drill costs approximately 1500 Indian rupees (20 US Dollars), and the hardware's modification of the reaming system costs an additional 2500 Indian rupees (nearly 30 US dollars), another excellent reason justifying its modifications. Our electric drill modified to support reaming costs almost a quarter of Bosch battery drills that lack reaming capability. In contrast, conventional orthopedic battery drills and pneumatic drill systems cost 150 times more. Concerns about sterility, heat-induced bone necrosis, power cord concerns, and maintenance issues are the most common reservations about using electric drills in orthopedic surgery.

Matthews and Hirsch observed no significant thermal change when drilling human cadaveric femora at rates ranging from 345 to 2900 revolutions per minute, indicating that overheating was more dependent on the drilling pressure (2). Sharawy proved in a comparable study that raising the rotational speed from 1225 to 2500 rpm reduced heat output (3). The bit's design, bone resistance, rotational speed, and the force produced at the cutting edge of the drill's bit contribute to heat generation and thermal necrosis in bones (4). It is widely believed that an electric drill is insufficient for orthopedic use because of bone splintering/overheating, etc. However, when we evaluated the Bosch battery drill, Stryker system 6, and an electric drill, we discovered that they all were comparable in terms of RPM and weight (Table 1).

Table 1. Comparison of Three Types of Drills

Specifications	Electric Drill (Modified)	Orthopedic Battery Drill (Stryker System 6)	Bosch Battery Drill, Model Number GSB 180
Weight	1.5 kg	1.7 kg with battery	3.44 kg with battery
Speed	2800 RPM	Up to 1500 RPM	Up to 1700
Sterilization	EtO, Formalin chamber, Formalin Autoclav	Autoclave, EtO	Formalin chamber, EtO
Reaming	Possible	Possible	Not Possible
Drilling	Possible	Possible	Possible
K-wire	Possible	Possible	Possible
Wattage	220 - 230W	220 - 230 W	220 - 230 W
Battery	NA	14 V on the charger	18 V
Torque	Not specified, but more than battery drills	Not specified in the brochure	54 Newton meters
Price USD	50	7840	210
Maintenance	Very cheap and freely available	Very high with a considerable lag time	Cheap and freely available

Because the electric drill is composed of plastic and iron, it cannot be autoclaved. Goveia et al. investigated the efficacy of EtO in sterilizing electric drills and confirmed that this process was safe and effective in sanitizing, allowing the reuse of electric drills (5). In 1969, Taylor and Barbeito demonstrated that formaldehyde gas was able to thoroughly decontaminate laboratory chambers and instruments, so we housed our drill in a formalin chamber for this purpose. The source of this gas is paraformaldehyde powder, which can inhibit the growth of viruses and both sporicidal and non-sporicidal bacteria and neutralize their toxins. Formaldehyde, often known as formalin, is an excellent disinfectant for facemasks used to protect against the SARS-Cov-2 virus, as reported by Garcia-Haro et al. in 2021 (6). Electric drills can also be sterilized in a Formalin autoclave at 65 degrees Celsius, where residual formalin will be negligible, and sterilization levels are comparable to that of EtO (7).

Following surgery, the drill's surface is cleaned with alcohol and hydrogen peroxide before being placed into the formalin chamber. We also draped the drill with autoclaved stockinet or drapes to avoid direct contact with blood and water during the operation and to enhance protection (8). Alternatively, we can also employ ready-to-use sterile camera covers to prevent blood smudging and boost its longevity.

The modified electric drill can be used not only to drill K-wires but also to ream the medullary canal and tap utilizing the reverse and forward triggers. Among the disadvantages of electric drills are the inability to attach the K-wire collet system, the lack of a paired-saw system, and, albeit minor, cable concerns. Electric drills have most of the functionality of a premium orthopedic drill for less than 150 times the price. We eliminated a significant disadvantage of the electric drill by cannulating it, making it comparable to orthopedic battery drills. As a result, we encourage and advocate for the routine use of electric drills without reservation in most trauma procedures, including nail reaming, in countries with limited resources.

3.1. Conclusions

The literature contains adequate evidence to refute misconceptions about electric drills' overheating and inducing bone thermal necrosis. There are various scientifically validated methods for sterilizing the electric drill effectively. Due to its affordability and ease of maintenance, our inventions, such as speed control and drill cannulation, make this device an all-purpose piece of equipment for most trauma surgeries, particularly in countries with poor economies.

3.2. Declaration of Interest

We did not receive any specific support from funding agencies in the public, commercial, or not-for-profit entities.

3.3. Ethical Statement

We explained the procedure to the patient in his native language and obtained permission to submit the article and accompanying photographs for publication.

Acknowledgment

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