

Fractured Tooth Stabilized with Auto Body Repair Resin on a 1970 Royal Navy Polaris Submarine Patrol

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INTRODUCTION: In February 1970, halfway through a Polaris submarine war patrol in SSBN-02 HMS *Renown* (port crew), a Petty Officer presented to the sick bay in excruciating pain with a broken upper left molar tooth. The zinc oxide/clove oil mixture would not stick on to the vertical face of the fracture. In preparation for such events, Royal Navy (RN) submarine medical officers are taught excellent fundamental dental skills. In this case, it seemed a very difficult job to extract the remains of the tooth. The author reports the first known use of glass fiber/resin in the RN to crown and treat a fractured molar, cover the root, and save the tooth, and to recommend that all military and civilian medical staff working anywhere in isolation with no dental facility locally be given similar training to that which RN submarine medical officers receive before being sent on extended dives.

KEYWORDS: dental, resin, marine, history, fracture, molar.

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When the author joined the Royal Navy (RN) submarine service in 1967, service on board nuclear submarines, both fast attack or missile boats (SSBN), for physicians was in its infancy. There were only five trained medical officers in the system who had served in an RN fast attack nuclear submarine (*Dreadnought*, *Valiant*, both in commission, and *Warspite*, which was just completing sea trials) and two medical officers who had just completed training who were standing by at the building of the first SSBN-01 boat HMS *Resolution* at Vickers shipyard in Barrow in Furness.

Four volunteers for the Port and Starboard crew, including myself, were chosen to serve in the second SSBN HMS *Renown* (built at Cammell Lairds in Birkenhead) and *Repulse* (the third SSBN at Vickers). In September 1967, specific multiple courses commenced at the Institute of Naval Medicine in Alverstoke, Gosport. To my knowledge, at that time, no medical officer, even those five physicians who had been trained by the U.S. Navy, had experienced a full SSBN 60-d patrol without surfacing, snorting, or coming to periscope depth, or in dire emergency come to periscope depth and ventilated the boat by running the main blower. The only information available was anecdotal information (sometimes alarming) that had been gleaned from the original basic training from the U.S. Navy in Groton, CT. For instance, it was believed that appendices would

have to be removed under local anesthetics on the wardroom table, and there would be fuel element leaks with the air particulate detector alarms going off, resulting in the reactor scrambling, and so forth.

Theoretically, the crew were fit and healthy with no medical risk factors. The selection process was extensive; not only was there the positive vetting security process due to the current Philby, Maclean, and Profumo spy scandal, but there was a medical screening process too. The author was working in the HMS Dolphin submarine base sickbay prior to being posted on course and later to the boat. At Dolphin, every submariner who volunteered to convert from diesel to nuclear boats was screened. One day, the Principal Medical Officer threw his hands up in the air and said that at the rate diesel boat crew were being rejected, it would barely be possible to crew one Polaris submarine from the entire fleet of submariners. So, essentially, the process was modified and only

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extreme cases were rejected. The primary question for the training system was what should be taught on the submarine medical officer course?

Between the Royal Navy Hospital at Haslar and Institute of Naval Medicine, their team did a very fine job and this paper will report on the results of the dental training, how it impacted on HMS *Renown's* first 60-d war patrol commencing in January 1970, and a cautionary note for medical staff that a fractured tooth with no local dental facility may need novel approaches to avoid aborting the mission.

Initial Dental Training

The dental course at the Royal Navy Hospital consisted of 4 h of lectures on general dentistry, how to use the RN 'Pusser' dental kit to fill a tooth, how to repair a broken tooth, how a tooth is held into the socket, and how to extract it. The 'Pusser' kit consisted of a small rectangular canvas khaki colored bag that contained dental needles and syringes, Novocaine local anesthetic, zinc oxide powder, clove oil, gauze sponge rolls, and the dental extraction tongs. The dental extraction tongs were demonstrated and it was explained how each tong extracted which tooth. Then, in the classroom, each student had to practice the pressure required to apply into the socket and the lever maneuver to do an extraction. The following day, these skills were put into practice in the Operation Room at Haslar Hospital in Alverstoke.

There was a full list of patients requiring total extractions. The four students were allocated about 2 h of Operation Room time to extract a lot of teeth. It was not as easy as thought, but once the technique was acquired, it did become easier. It was great training and a good confidence builder.

The Fractured Upper Left Molar

In spite of the fact that the entire crew had been screened by the dentist around 2 to 4 wk before patrol, sometime in February 1970, 34 d into HMS *Renown* (Port crew) war patrol (Fig. 1), a



Fig. 1. SSBN 02-HMS *Renown* steaming down the Gareloch from the Faslane submarine base, Scotland, in 1969.

Petty Officer burst into the sick bay in agony. The patient had been eating a piece of Christmas cake just before going on watch and a hard piece of icing sugar fractured his left upper back molar tooth.

The immediate problem was that he was in severe pain. After being at sea submerged for 34 d, even small events become very major events, so the Coxswain and Chief Stoker were lined up outside the tiny sick bay (Fig. 2) demanding to know what the doctor was going to do about it all, and the Jimmy (the Executive Officer) was hovering around, too. Many of the operational staff would have preferred to replace the physician in the crew with another technical officer, so this was a challenge that could not be messed up, causing loss of credibility to the medical branch and an excuse for the Executive Branch to fill the precious bunk space with a watchkeeper rather than a physician.

Gauze was placed in the patient's mouth to stop him salivating to see what had happened. Theoretically this sounded easy—a dentist is really good at this—but practically for a neophyte, it is not so. His mouth was full of gauze and he looked like a hamster, and then, with the flashlight, it was not possible to see what was going on. The next move was to give the patient a shot of morphine to alleviate the pain. Now the Coxswain was in battle mode and drew a tot of rum and stated that according to one of the Queen's Regulations and



Fig. 2. The sick bay measuring 11 ft by 6 ft. X marks the spot where the procedure took place on this bunk.

Orders, under the circumstances, the patient was allowed a medicinal tot.

This provided a few minutes respite to reassess the situation. The posterior upper left molar was transected from top to bottom, exposing the whole of the root, just like the dental training pictures. There were 26 more days on the war patrol before return to Faslane, Scotland. *Renown* was not aborting this mission for a dental emergency.

Out came the Pusser kit, the clove oil, the zinc oxide, and the china mixing tablet. There was instant relief when zinc oxide was applied to the vertical face of the tooth and covered the root, but it would not stick. It also became clear it would be a very difficult task to extract the remaining tooth. There was no IV; back then, diazepam was used for sedation if this process had even been considered.

Organic based solvents in whatever form are disallowed on nuclear submarines. Not only are they toxic in a confined space, but if they off-gas in the boat, they pass through the carbon dioxide/hydrogen burners in the air conditioning plant. Here, they are converted to very nasty biproducts and also corrode the cooling vanes in the exhaust trunking of each unit. Many of the ship's company in surface vessels were keen on model making when at sea, but the glues and resins were generally benzene, toluene, or xylene-based and, therefore, forbidden on nuclear boats. However, crew still smuggled some of these items on board. It was thought that some glass-fiber mixture may have a chance of sticking. Nothing ventured, nothing gained, as something had to be done.

After a pipe was made over the main broadcast requesting any model making equipment, a hand came around the sick bay door and anonymously delivered a pack of Halfords 'Bondo' auto body repair kit. It contained the resin, the powdered glass-fiber, and the curing agent. In the meantime, the Coxswain decided the patient was not sedated enough and issued another tot courtesy of Her Majesty!

The glass-fiber powder, resin, and curing agent were prepared, the gauze swabs were replaced, the patient's mouth jammed wide open with tongue depressors, and the mixture applied to the tooth. Even though plenty of curing agent had been added to the mixture, after half an hour, it had not set and fell off. It was probably because of the high humidity in the patient's mouth, or, in retrospect, the fact that the tooth was not acid etched.⁶

By now the entire ships' company not on watch was providing advice and it was decided to conduct a few experiments pre-curing the mixture in the galley oven. Chosen were 2, 5, 7, and 10 min of preheating. At each time interval, an attempt was made to stick the specimen on to a dinner plate that had previously been held under a steaming kettle. The 2-min period was not enough—the mixture stuck, but did not cure and stick; 7 and 10 min were too much—the mixture had already hardened and would not initially stick at all. The 5-min period seemed to be just about right.

Around 4 h had passed by the completion of the experimentation and the patient was starting to feel the pain again and was salivating profusely. He was administered another shot

of morphine. It is easy to be wise after the event and, of course, atropine would have been indicated to stop the salivation. The gauze was replaced, the tongue depressors were inserted, the mixture was prepared, and placed in the oven. At exactly 4 min later, the Sick Bay Chief took it out and came running down to the sick bay. This time it stuck to the patient's tooth. With all that morphine and two tots, he slept for 12 h solid, then asked if he could have a steak. Boiled fish and rice pudding were prescribed for the rest of the patrol.

At the end of the patrol, the dentist called and asked what had been used as a filling because regular burrs would not remove it! He reported that it was a good job and the tooth had been saved.

DISCUSSION

It is doubtful that a young Medical Officer early in his/her career would see a dental emergency and might not understand how such a simple broken tooth may incapacitate a patient. Yet such physicians often chose to work in isolated situations without a dedicated dental department. Even though, according to the regulations, the Petty Officer had received a dental checkup before the 60-d dive, as has been written many times, a predental check before an isolated mission does not guarantee that this will not occur.

The reason for this report after 50 yr is to emphasize that nothing has changed. Any person who takes part in an extended submarine dive, space travel, lengthy journeys in the wilderness such as the North or South Pole, or special combat troops operating in isolated inhospitable places without an immediate dental facility close by are potentially at risk. Inaction is not an option and unless treated may jeopardize the mission. Therefore, supervisors of all the people named at risk above should ensure that the medical staff get at least as good training as was provided for medical officers on *Polaris* nuclear submarines all those years ago. Without that, it could have turned out to be a very nasty experience. It was clear that the tooth would break off even if consideration had been given to putting a set of dental tongs close by.

In 55 yr as a physician, except for the delivery of primiparous twins, the second one being a breach delivered single handed, in the middle of the night in a gypsy caravan by the light of one kerosene lantern by the Erewash (sic) Canal in Nottingham, UK, this has been the most technically challenging job encountered in the author's profession. The Royal Navy dental training was first class, both in time allocated to theory and the practical Operating Room time. Because many submarine operational details are classified, it is hoped that dental resin and acid etching material is now included in the latest 'Pusser Kit.'

Not being dentally trained, it is only possible to refer to the overall literature on the replacement of mercury amalgam by resins. The idea was conceived in the late 1950s, but the first positive step appears to be that of Rafael Brown, who developed the Bis-GMA thermoset resin for dental restorations in

1962,^{1,4,5} but it did not come into common use with the acid etching until the mid-1970s.^{2,3,6} This is the first time that resin may have been used in a clinical dental emergency to crown a fractured tooth and certainly the first use in the Royal Navy Submarine service.

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