

# The *Titanic* Disaster: Dentistry's Role in the Identification of an 'Unknown Child'

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The Royal Mail Ship (RMS) *Titanic* had a brief and inglorious history that culminated with her striking an iceberg and sinking at 0220 on April 15, 1912, while on her maiden voyage.<sup>1</sup> The Cunard liner *Carpathia*, steaming a distance of 47.3 nautical miles in 3.5 hours, was the first ship to arrive at the disaster scene at 0400.<sup>2</sup> By 0830, the *Carpathia* had picked up 712 survivors and steamed on to New York, where she docked at Cunard's pier 54 at around 2100 on April 18, 1912.<sup>1</sup> Meanwhile, a call went out to Halifax, N.S., for body-recovery ships. Before sailing, these ships were equipped with coffins, ice, embalming fluid and undertakers. A total of 4 Canadian vessels were involved: the *Mackay-Bennett*, the *Minia*, the *Montmagny* and the *Algerine*. These ships respectively recovered 306, 17, 4 and 1 bodies.<sup>3</sup> Some of these bodies were buried at sea, while others were transported back to Halifax for possible identification and burial. A further 9 bodies were recovered and buried at sea by other ships.

Captain Frederick H. Larnder of the *Mackay-Bennett*, on arriving at the disaster scene, described it as, "Like nothing so much as a flock of gulls resting upon the water... all we could see at first would be the top of life preservers. They were all floating upwards, apparently standing in the water."<sup>3</sup> An 'Unknown Child', a male child of an estimated age of 2 years, was the fourth body recovered by the crew of the *Mackay-Bennett* in the first boatload of bodies early on the morning of Sunday, April 21, 1912. As reported in the *Halifax Morning Chronicle* from a member of the crew of the *Mackay-Bennett*, "The little body floated up alongside the searchers' boat and it was tenderly taken on board. The sight of this little form floating face upwards brought tears to the eye of many of the hardy sailormen."<sup>3</sup> The crew

vowed that if the body was unclaimed, they would be responsible for its burial and they were true to their word.<sup>3</sup> Body number 4, an 'Unknown Child' was buried — along with 120 other victims of the disaster — in Fairview Lawn Cemetery in Halifax (Fig. 1). Of the 2,208 people on board the *Titanic*, 1,496 lives were lost in the disaster.<sup>4</sup>

## The *Titanic* Ancient DNA Project

The *Titanic* Ancient DNA Project was begun in the late summer of 1998.<sup>5</sup> Dr. Ryan Parr, vice-president of research and development of Genesis Genomics Inc. (on the campus of Lakehead University in Thunder Bay, Ont.) and Alan Ruffman, president of Geomarine Associates Ltd. in Halifax, applied for and received permission to excavate and exhume the remains from the graves of bodies number 240, 281 and 4 at the Fairview Lawn Cemetery. This application was made on behalf of 3 different groups of families who were hoping to identify a particular body as a member of their family. Body number 4 was that of the 'Unknown Child'. The exhumations occurred on May 17 and 18, 2001, under strict forensic conditions.<sup>6</sup>

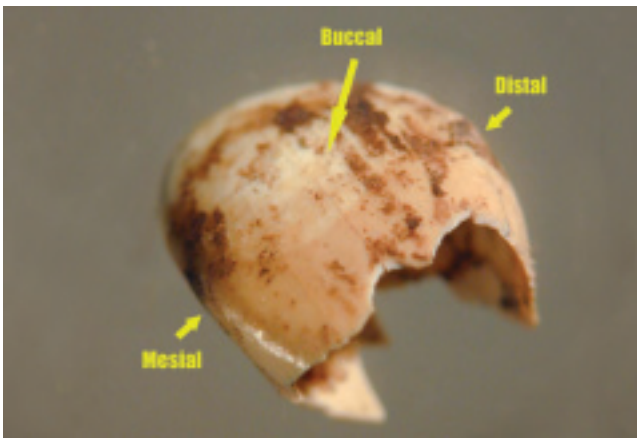
The request for exhuming body number 4 was made by the Pålsson family from Sweden. It had been speculated that two-year, three-and-a-half-month-old Gösta Leonard Pålsson could have been the 'Unknown Child.' Owing to the nature of the soil and the slightly acidic (pH 5.04) groundwater, the remains associated with graves of bodies number 240 and 281 had all decomposed and dissolved. A "small fragment (6 cm) of poorly preserved bone" and 3 teeth were recovered from burial number 4, the 'Unknown Child'.<sup>6</sup>



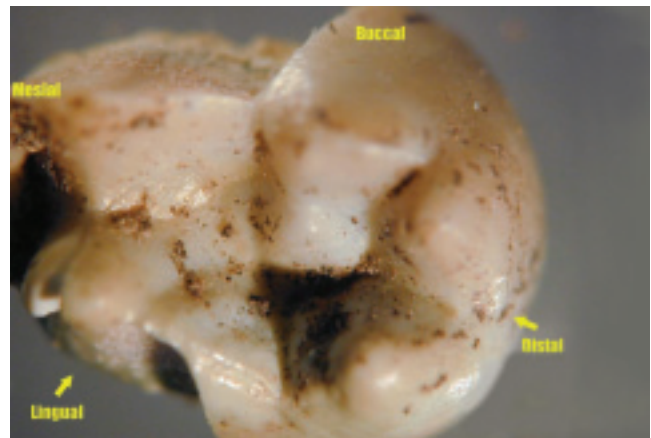
**Figure 1:** Grave of an 'Unknown Child,' Fairview Lawn Cemetery, Halifax, Nova Scotia. Photo courtesy of Scott I. Fairgrieve.



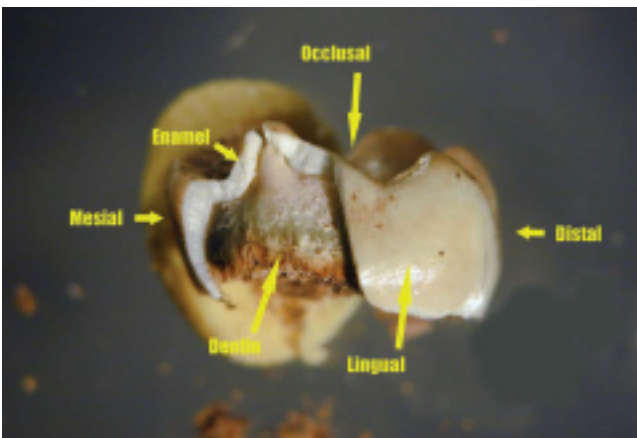
**Figure 2a:** Photograph of the occlusal surface of tooth 55 showing lack of occlusal wear.



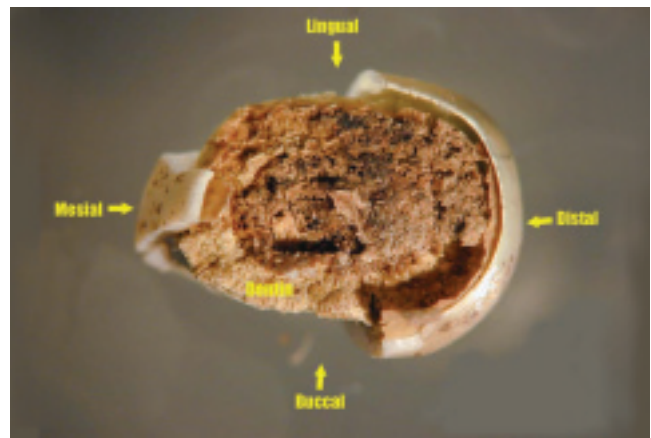
**Figure 2b:** Photograph of the buccal surface of tooth 73 showing lack of incisal wear.



**Figure 2c:** Photograph of the occlusal surface of tooth 84 showing flaking away of mesiobuccal and distolingual enamel and lack of occlusal wear.



**Figure 3:** Photograph of the lingual surface of tooth 84 showing the underlying dentin where lingual enamel has been lost.



**Figure 4:** Photograph of a ventral view of tooth 84 showing the dentin on the periphery and debris filling the pulp chamber.

By the spring of 2002, Parr and Ruffman were able to conclude that the 'Unknown Child' was not Gösta Pålsson, based on a mitochondrial DNA comparison between the bone fragment and living direct maternal descendents in

Sweden.<sup>6,7</sup> At this point, the teeth began to play a role in the investigation. Dr. J. El Molto, an anthropologist and the director of the Paleo-DNA Laboratory at Lakehead University, suggested that the 3 teeth were the deciduous

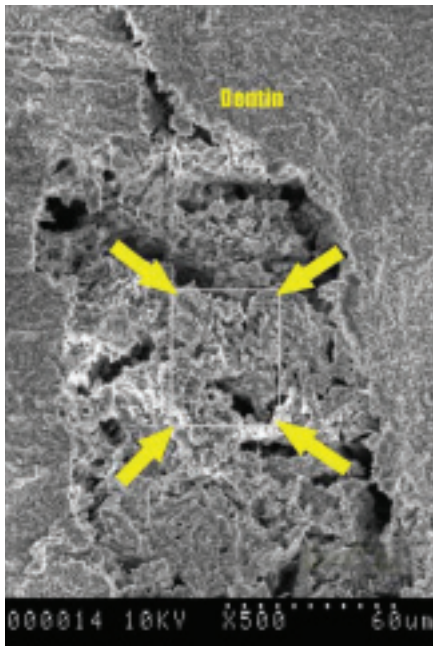


Figure 5a: SEM (x500) of the lingual surface of tooth 84, denoting an area where dentinal structure was identified at higher magnifications.

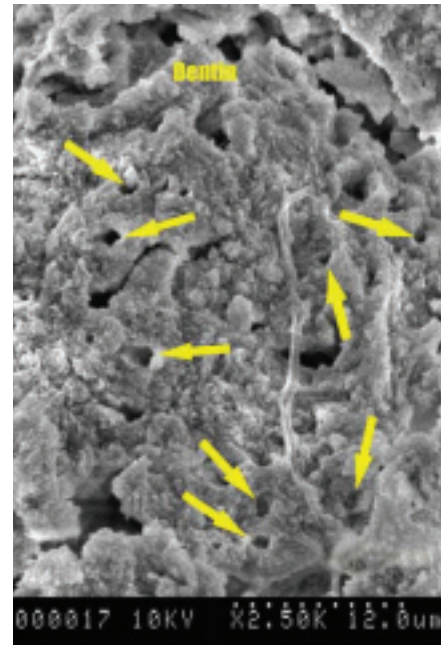


Figure 5b: SEM (x2500) of the lingual surface of tooth 84. The arrows point to dentinal tubule orifices.

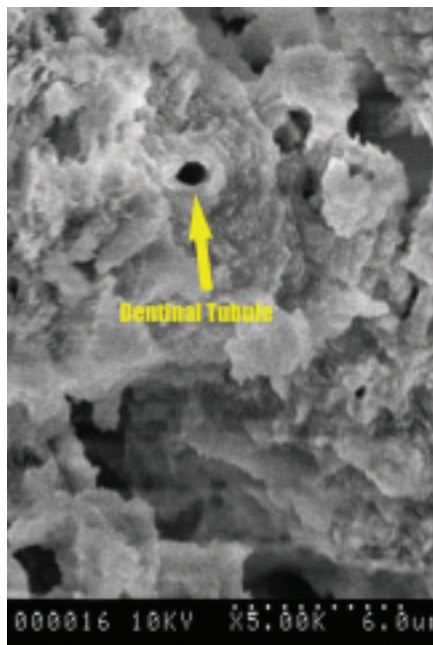


Figure 5c: SEM (x5000) clearly showing the orifice of a dentinal tubule.

teeth of a quite young child. The teeth were sent to Dr. Christy Turner II at the State University of Arizona in Tempe, and he too agreed. Ruffman then concentrated on finding direct descendants of the 2 youngest of 6 male children who had died during the sinking of the *Titanic*. Relatives were found and they participated in the study by donating 6 or 7 drops of blood. These were then processed at Genesis Genomics in Thunder Bay; by the early summer of 2002, Parr and Ruffman knew that these 2 young males

were not the 'Unknown Child.' Ruffman then began to search out the direct maternal descendents of the remaining candidate male children. Parr and Ruffman also looked for help with the teeth since "we really began to have doubts as to what the teeth were telling us."<sup>8</sup>

### The University of Toronto

Following a discussion with Parr, the teeth recovered from body number 4 were brought from Lakehead University to the University of Toronto by Bruce Pynn, an oral and maxillofacial surgeon. He suspected that one of the teeth contained dentin. The teeth were in a very fragile condition and handled at all times using rubber gloves and sterile dental forceps, so as not to contaminate any residual DNA that might be in the teeth, which consisted of crowns with no visible evidence of root formation (Figs. 2a, 2b and 2c). Pediatric dentists Keith Titley and Gajanan Kulkarni and dental anthropologist John Mayhall, with the use of an appropriate dental anatomy text, identified them as being:<sup>9</sup>

- maxillary right second primary molar: 55
- mandibular left primary cuspid: 73
- mandibular right first primary molar: 84

Because of the stage of development of their crowns, their lack of root development and lack of wear, the teeth were tentatively estimated as coming from a child of 9 to 15 months of age (Table 1).<sup>9</sup>

The teeth were photographed with a digital camera at magnifications of x30 to x60 on an Olympic model SZX-ILLD100 binocular light microscope (Olympic

**Table 1** Chronology of tooth development (adapted from Scott and Symons<sup>9</sup>)

Primary teeth	Formation of crown complete	Appearance in oral cavity
Incisors	2–3 months	6–9 months
Cuspids	9 months	16–18 months
First molars	6 months	12–14 months
Second molars	12 months	20–30 months

Optical Co. Ltd., Mito City, Japan). Teeth 55 and 73 were simply enamel shells with no evidence of any internal structure. Some solid debris was noted inside the crown of tooth 84 where enamel had flaked away from the distolingual and buccolingual surfaces, revealing the possible presence of underlying dentin (Figs. 2c and 3). A ventral view of the crown showed a considerable amount of debris in the pulp chamber with material that could be considered to be dentin (Fig. 4).

As a result, the teeth were carefully mounted on aluminum scanning electron microscopy (SEM) stubs with double-sided tape, sputter-coated with 1 nm of platinum in a Polaron E5100 coating unit (Polaron Equipment Ltd., England) and examined with a Hitachi S-2500 SEM (Hitachi Ltd., Mito City, Japan) at an operating kilovoltage of 10 kV. The buccal and lingual surfaces that had been denuded of enamel were scanned at increasing magnifications of  $\times 500$ ,  $\times 2500$  and  $\times 5000$  until the presence of tubular orifices that were consistent with those of dentinal tubules were confirmed and photomicrographs taken (Figs 5a, 5b and 5c).

### The 'Unknown Child' Identified

Following the work performed in this laboratory, confirming the presence of dentin in tooth 84, the teeth were returned to Parr at Lakehead University. From there, tooth 84 was taken to the ancient DNA laboratory of Dr. Scott Woodward of Brigham Young University in Provo, Utah, where non-nuclear DNA, known as mitochondrial DNA (mtDNA), was recovered from the dentin. All mtDNA is inherited from our mothers and, within the molecule, is archived a biochemical 'family name' that is not only stable but persists in maternal family lines for generations.<sup>7,10</sup> Parr and Woodward also obtained a new extraction of mtDNA from the bone fragment that had none of the contamination problems previously encountered. As a result, the mtDNA from tooth 84 and from the bone fragment were found to match, so that the researchers knew they had the true mtDNA of body number 4. Geneologists were able to track down living maternal relatives of all the children under age 3 who perished on the *Titanic* and were able to obtain DNA samples from them.<sup>11</sup> There were 2 of the candidate male children within the estimated age-range who had the same mtDNA: Sidney

Leslie Goodwin, aged 19 months, from Melksham in southern England; and Eino Viljam Panula, aged 13 months, from Ylihärmä in Finland. When the mtDNA results came in from the direct maternal descendants of the Goodwin and the Panula children, both had the same mtDNA. As it turned out, their mtDNA is found in over 15% of indigenous Caucasians of northern Europe, indicating that somewhere in the past 2,000 years, the 2 families had a common maternal antecedent. Because of the early stage of dental development of body number 4, however, the Finnish child (13-month-old Eino Viljam Panula) was finally identified as the 'Unknown Child'.<sup>12,13</sup> The press release by Genesis Genomics announcing the identification of the 'Unknown Child' subsequently received extensive coverage in the Canadian press.<sup>14–16</sup> Teeth 55 and 73 will be re-interred at the burial site; tooth 84 was consumed in the DNA extraction at Brigham Young University in August of 2002.

In conclusion, the teeth were instrumental in determining the identity of the 'Unknown Child' and the University of Toronto was able to play a pivotal role in the interdisciplinary solving of this mystery, allowing the team of dentists to distinguish between the 2 male candidate children who carried the same mtDNA. Given the 6 months age difference between the 2 children, the teeth will now allow a name to be placed on the grave of an 'Unknown Child' in Halifax's Fairview Lawn Cemetery: Eino Viljam Panula. ♦

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*The views expressed are those of the authors and do not necessarily reflect the opinions or official policies of the Canadian Dental Association.*

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