When Marriage Hurts: A Literature Review of Embedded Jewellery Ring Injuries

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Abstract

A ring is traditionally worn as a symbol of love and affection or as decorative ornamental jewellery. However, rings are not without risk. The spectrum of danger can range from debilitating avulsion injuries to simple contact dermatitis. Unknown to many, an unusual rarity exists; previous authors have termed this entity 'embedded ring syndrome'. We sought to review the literature and collate evidence on the common features of this syndrome.

A literature review was performed on cases reported from 1947 to 2017 accessed through the healthcare database advanced search (HDAS). A total of 28 cases were analysed for demographics, symptomatology and operative techniques. Overall, 64.3% were females, and 50% had a psychiatric comorbidity. There was a causative event preceding the injury in 35.7% of cases; 71.4% had a reduced range of movement or reported a stiff finger and 32.1% had reduced sensation. The majority of patients underwent ring removal and primary closure, without documentation as to whether neurovascular bundles and tendons were visualised.

Embedded ring injuries are rare. Consequently, information is sparsely available regarding its natural history and management. The hand surgeon's approach requires an understanding that the chronicity of these injuries can have a significant traumatic impact on the structures of the finger.

Introduction And Background

It is believed that ancient Egyptians first established the custom of ring bearing to reflect the eternity of their marriage: impervious and unbroken. Legend has it that they bore rings on the fourth finger as vena amoris connected this digit directly to the heart. Such a vein does not exist; indeed, the circulatory system was unknown at the time [1,2].

Today, many people choose to wear a ring or 'wedding band', which is usually forged from metal. Commonly, ring entrapment can occur secondary to the swelling of a digit. It is unmoveable past the proximal interphalangeal joint secondary to pregnancy, allergic reaction or infection, or simply as a result of a tightfitting ring. There are well-established methods for entrapped ring removal in the emergency department such as the winding technique, which uses thread to compress the finger, or using manual ring cutters to saw the ring [3]. Rarely, they can result in complex traumatic avulsion injuries to the hand when the ring is caught on an object and forcefully pulled. These injuries can necessitate a range of treatments, from simple wound closure through to microvascular repair and amputation [4]. Rarer still, a ring can become embedded into the soft tissue of a digit to the extent that it is not at all visible to the eye. This unusual phenomenon has previously been described as ‘embedded ring syndrome’ [5]. An embedded ring can be seen as the re-epithelialisation of skin over any part of the ring resulting in the formation of a skin bridge. Figure 1 shows an example of an embedded ring. The literature is limited to sporadic case reports, and the majority of authors and patients have presented their cases in the context of extreme rarity. Within this review, we aim to amalgamate the available data and identify the common features.
Review

We utilised the National Institute for Health and Care Excellence (NICE) Healthcare Database Advanced Search (HDAS) via OpenAthens to search PubMed, MEDLINE, EMBASE and EMCARE databases from their inception until August 2020. The following search terms were used: ‘embedded ring injury/injuries’ or ‘ring injury/injuries’ or ‘embedded ring syndrome’ both independently and combined with ‘ulceration’ ‘erosion’ ‘digit’ ‘finger’ or ‘retained.’ Articles were included for patients of any age range and demographic. Excluded articles were those that described ring injuries without any epithelialisation/’skin bridge’ over the ring, articles relating to ring entrapment rather than embedded rings and articles not written in English text.

Figure 2 shows an outline of the systematic literature search that was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses System (PRISMA) statement for study selection [6]. Two authors independently screened the 60 articles that were retrieved through the database search. The references of retrieved articles were traced for citations missed by the electronic search; this yielded a further six articles. Thirty one irrelevant and duplicate articles were removed. Three articles were excluded as they were presented in a foreign language. After screening, 32 full-text articles were selected for further evaluation: five articles were excluded as they were non-embedded cases. A total of 27 were finally put forward for analysis; 26 articles presented one case each and one article presented two cases. There was no disagreement in study selection between authors.
A total of 27 reports were analysed dating from 1947 to 2017 [5,7-32]. Given its unusual and rare nature, some of the information reported was sporadic and without structure. Information regarding patient demographics, symptomatology and operative techniques were collected where available. Table 1 shows the patient demographics and any reported causative event, as well as the reported length of time over which the injury had occurred.

| Author            | Gender | Age | Medical Comorbidity | Psychiatric Comorbidity | Causative Event                        | Duration of Symptoms | No. of Digits Involved | Digit(s)      |
|-------------------|--------|-----|---------------------|-------------------------|----------------------------------------|----------------------|------------------------|---------------|
| Awan et al. [7]   | F      | 16  |                     | Intellectual disability | No                                     | -                    | 1                      | Index finger |
| Balakrishnan and Nyitray [8] | F      | 24  |                     | Intellectual disability | -                                      | -                    | 1                      | Ring finger   |
| Bennett et al. [9] | M      | 13  |                     |                         | No                                     | 1 month               | 1                      | Ring finger   |
| Zeng et al. [10]  | M      | 18  | No                  |                         | yes; secondary to amphetamine abuse    | Trauma 2 weeks        | 1                      | Middle finger |
| Deshmukh and Stothard [11] | M      | 22  |                     | Yes; unspecified         | -                                      | -                    | 1                      | Middle finger |
| Drake et al. [12] | F      | 39  |                     | Yes; unspecified         | -                                      | -                    | 1                      | Middle finger |

Diabetes mellitus,
| Authors | Gender | Age | Diagnosis/Event | Duration | Additional Details | Finger(s) |
|---------|--------|-----|----------------|----------|-------------------|-----------|
| Drewniany et al. [13] | F | 62 | cerebrovascular accident | - | No | 1 | Ring finger |
| Fraser and Jamison [5] | M | 28 | - | - | No | 1 | Ring finger |
| Freedman [14] | F | 73 | Heart failure, diabetes mellitus, anaemia | - | Trauma | 9 years | Ring finger |
| Hove and Odland [15] | F | 36 | Intellectual disability | - | 31 years | 1 | Ring finger |
| Kattan et al. [16] | F | 17 | - | - | Trauma | 3 months | 1 |
| Kumar et al. [17] | M | 49 | Schizophrenia, depression | Trauma | 3 months | 1 | Index finger |
| Kuschner et al. [18] | M | 44 | Yes; unspecified | - | - | 2 | Ring and middle finger |
| Kuschner et al. [18] | M | 48 | Schizophrenia | - | - | 1 | Thumb |
| Langridge et al. [19] | F | 45 | - | Insect Bite | Several months | 1 | Ring finger |
| Leung and Ip [20] | M | 71 | - | No | - | 1 | Ring finger |
| Magos & Sheikh [21] | F | 71 | Subarachnoid haemorrhage | No | Trauma | 9 weeks | 1 | Ring finger |
| Moore et al. [22] | M | 41 | HIV | Schizophrenia | - | Several years | 1 | Index finger |
| Prasad et al. [23] | F | 7 | - | - | - | 4 years | 1 | Index finger |
| Reguesse et al. [24] | F | 69 | No | - | No | 1 | Ring finger |
| Rohilla et al. [25] | M | 22 | - | No | Trauma | 1 week | 1 | Middle finger |
| Saltz et al. [26] | F | 23 | Yes; unspecified | - | - | Several months | 1 | Little finger |
| Shafiroff [27] | F | 29 | Intellectual disability | Rapid weight gain | 4 months | 1 | Ring finger |
| Sleilati et al. [28] | F | 63 | Intellectual disability | - | - | 1 | Ring finger |
| Uemura et al. [29] | F | 73 | Yes; unspecified | Trauma and rapid weight gain | 10 years | 1 | Ring finger |
| Unlü et al. [30] | F | 54 | No | No | No | 1 year | 3 | Ring, middle and index finger |
| Witt [31] | F | 8 | No | No | Trauma | 3 months | 1 | Ring finger |
| Woodhouse [32] | F | 47 | - | - | - | 3 months | 1 | Ring finger |

**TABLE 1: Patient demographics**

Note: Unrecorded data are represented by '-'

Patients ranged from 7 to 73 years of age. Excluding the three paediatric patients aged 7, 8 and 13, there was...
an average adult age of 43.3 years; 64.3% were female (n=18) and 35.7% were male (n=10). Also, 64.3% of authors (n=18) did not comment on any medical comorbidities, 21.4% reported none (n=6) and 14.3% stated patient comorbidities (n=4).

Of the 28 patients, 50% (n=14) had a psychiatric comorbidity, whilst 25% (n=7) had none; the remaining 25% (n=7) of reports did not make any reference to psychiatric comorbidity. The diagnoses included intellectual disability, schizophrenia, mental illness secondary to drug abuse and depression. Five authors referred to a psychiatric comorbidity but did not specify the diagnosis. None of the three paediatric cases reported a psychiatric diagnosis.

Of the patients, 35.7% (n=10) reported a causative event correlating to the onset of symptoms. This included a clear history of traumatic injury to the finger, rapid weight gain and insect bite. Also, 21.4% (n=6) reported no obvious preceding event, and for the remaining 42.9% (n=12), no information was given or a history could not be obtained due to psychiatric comorbidity.

Overall, 60.7% (n=17) reported a time duration of symptoms before presentation whilst 39.3% (n=11) did not. Three authors did not objectively quantify the reported durations, instead they referred to the time period as ‘several months/years’. Of the patients, 7.1% (n=2) had embedded ring symptoms develop over less than one month, 32.1% (n=9) developed over one month to one year and 21.4% (n=6) developed over the course of more than one year; 39.3% (n=11) did not report a duration of symptoms.

There were two cases of rings embedded on multiple fingers, and the remainder of cases involved only one digit. The ring finger was the most common digit to have an embedded ring. Figure 3 shows the distribution of embedded rings by finger involved.

Table 2 shows the clinical findings recorded of the patients with embedded rings. The commonest position of a skin bridge was on the volar aspect of the finger (67.9%, n=19). Dorsal skin bridges occurred in 10.7% (n=3). Completely circumferential skin bridges (i.e. an invisible ring) occurred in 10.7% (n=3). Position of skin bridge was not clear in two cases (7.1%). One case (3.6%) had near-complete embedding: skin bridging on the dorsal, volar and ulnar border of the finger but visibility of the ring on the radial border. Moreover, 35.7% (n=10) had pain/discomfort, 21.4% (n=6) had no pain/discomfort and 42.9% (n=12) did not report upon this finding.
| Study Reference | Volar/Dorsal/Ulnar | Normality | Sensitivity | Specificity | Secondary Outcomes |
|-----------------|--------------------|-----------|-------------|-------------|-------------------|
| Awan et al. [7]  | Volar, dorsal and ulnar border | No | Normal | No | Normal | Yes | Yes | No |
| Balakrishnan and Nyitray [8] | - | - | Normal | Normal | No | Normal | - | - | Yes |
| Bennett et al. [9] | Complete circumferential | - | Normal | Normal | Yes | Reduced | - | Yes | Yes |
| Zeng et al. [10] | Volar | Yes | Normal | Reduced | - | Reduced | Yes | Yes | Yes |
| Deshmukh and Stothard [11] | Volar | Yes | Normal | Normal | No | Reduced | - | Yes | No |
| Drake et al. [12] | Volar | - | Normal | Normal | Yes | Reduced | - | Yes | No |
| Drewsiany et al. [13] | Volar | - | Normal | Reduced | Yes | Reduced | - | - | - |
| Fraser and Jamison [5] | Volar | Yes | Normal | Normal | No | Reduced | - | Yes | - |
| Freedman [14] | Volar | - | - | - | Yes | Reduced | - | Yes | No |
| Hove and Odland [15] | Dorsal | Yes | Normal | Normal | Yes | Reduced | - | Yes | Yes |
| Kattan et al. [16] | Volar | - | - | - | Yes | - | - | - | - |
| Kuschnier et al. [18] | Dorsal | - | Normal | Reduced | No | Reduced | - | Yes | No |
| Kuschnier et al. [18] | Volar | - | Normal | Normal | - | Reduced | - | - | - |
| Langridge et al. [19] | Volar | No | Normal | Normal | No | Normal | No | Yes | No |
| Leung and Ip [20] | Volar | Yes | Normal | Normal | Yes | Reduced | - | Yes | Yes |
| Magos and Sheikh [21] | Volar | No | Normal | Normal | - | Normal | - | - | No |
| Moore et al. [22] | - | - | Normal | Reduced | No | Reduced | - | Yes | No |
| Prasad et al. [23] | Dorsal | No | Normal | - | Yes | Reduced | - | Yes | - |
| Reguesse et al. [24] | Volar | Yes; minimal | Normal | Reduced | No | Reduced; stiff | Yes | Yes | No |
| Rohilla et al. [25] | Complete circumferential | Yes | Normal | Normal | No | - | - | - | - |
| Saltz et al. [26] | Volar | No | Normal | Normal | - | No | Yes | Yes |
| Shafiiff [27] | Volar | - | Delayed CRT | Normal | - | - | Yes | Yes | Yes |
| Sleilati et al. [28] | Volar | Yes | Normal | Hyperaesthesia | Yes | Reduced | Yes | Yes | - |
| Uemura et al. [29] | Volar | - | Normal | Reduced | No | Reduced; stiff | Yes | Yes | Yes |
| Unlu et al. [30] | Volar | - | Normal | Reduced | Yes | Reduced; stiff | Yes | Yes | No |
TABLE 2: Comparison of clinical findings between reported cases

IPJ, interphalangeal joint; CRT, capillary refill time

Note: Unrecorded data are represented by ‘-’

The vast majority had normal vascular supply in the digit (85.7%; n=24), two reported delayed capillary refill times (7.1%) and 7.1% (n=2) did not report upon vascular status. Distal to the site of injury, 53.6% (n=15) had normal sensation and 32.1% (n=9) had reduced sensation. And, 3.6% (n=1) had hyperesthesia, 10.7% (n=3) did not report upon sensation, 39.3% (n=11) had a ring embedded into bone in addition to soft tissues, 35.7% (n=10) did not involve bone and 25% (n=7) were unreported.

Of the patients, 71.4% (n=20) had a reduced range of movement or reported a stiff finger. Normal range of movement (ROM) was described in 14.3% (n=4). Erythema was present in 35.7% (n=10) and absent in 7.2% (n=2). All cases that commented upon swelling stated that it was present in the offending finger (78.6%; n=22); 32.1% showed signs of infection (n=9) and 39.3% showed no signs of infection (n=11).

Table 3 shows the intraoperative findings. The available data on this aspect was sparse. A majority of authors reported using ring cutters to release the ring, with two using wire cutters and one using a tapered fissure burr. Only seven authors stated that they explored the wounds. Five authors commented on tendon integrity, with three reporting some degree of tendon rupture. Two authors reported collateral vessel formation as a result of the embedded ring [7].

| Author                   | Mode of Anaesthetic | Incision | Wound Exploration | Instrument for Ring Removal | Intraoperative Course                                                                 | Follow-Up                      |
|--------------------------|---------------------|----------|-------------------|------------------------------|--------------------------------------------------------------------------------------|--------------------------------|
| Awan et al. [7]          | Regional            | Yes      | Yes               | Ring cutters                 | Intact NVB and flexor tendons, neovascularisation, growth of NVB over top of ring: repair not required | Residual stiffness             |
| Balakrishnan and Nyitray [8] | -                   | -        | -                 | -                            | -                                                                                     | Return of normal ROM           |
| Bennett et al. [9]       | -                   | Yes      | Yes               | Ring cutters                 | Intact NVB                                                                            | Return to near-normal ROM      |
| Zeng et al. [10]         | -                   | No       | No                | Ring cutters                 | -                                                                                     | -                              |
| Deshmukh and Stothard [11] | -                   | -        | -                 | Ring cutters                 | -                                                                                     | -                              |
| Drake et al. [12]        | General             | Yes      | No                | Ring cutters                 | -                                                                                     | Restricted ROM                 |
| Drewmiany et al. [13]    | -                   | -        | -                 | Ring cutters                 | -                                                                                     | Restricted ROM, residual sensory disturbance |
| Fraser and Jamison [5]   | -                   | -        | -                 | Ring cutters                 | Intact NVB, intact flexor and extensor tendons                                        | -                              |
| Freedman [14]            | -                   | -        | -                 | -                            | -                                                                                     | Restricted ROM                 |
| Hove and Odland [15]     | Local               | No       | No                | Ring cutters                 | -                                                                                     | Restricted ROM                 |
| Kattan et al. [16]       | -                   | -        | -                 | -                            | -                                                                                     | -                              |
| Kumar et al. [17]        | -                   | Yes      | No                | Ring cutters                 | -                                                                                     | Return of normal sensation,     |
| Authors             | Type       | Yes/No | Tool(s)               | Description                                                                 | Outcome                                      |
|---------------------|------------|--------|-----------------------|-----------------------------------------------------------------------------|----------------------------------------------|
| Kuschner et al. [18] | General    |        | Ring cutters          | -                                                                           | Restricted ROM                               |
| Kuschner et al. [18] | General    | Yes    | Ring cutters          | -                                                                           | Restricted ROM                               |
| Langridge et al. [19] | General   | Yes    | Wire cutters          | Ruptured FDS, ruptured extensor digitorum, normal radial NVB (ulnar NVB not explored); tenolysis and tenosynovectomy of flexors and extensors | Return of normal ROM                         |
| Leung and Ip [20]   | Local      | Yes    | Ring cutters          | -                                                                           | Return of normal ROM                         |
| Magos and Sheikh [21] | Local     | No     | Ring cutters          | -                                                                           | Normal                                       |
| Moore et al. [22]   | General    | No     | Tapered fissure burr  | -                                                                           | Improved ROM, residual sensory disturbance   |
| Prasad et al. [23]  | General    |        | Ring cutters          | -                                                                           | Improved ROM                                 |
| Reguesse et al. [24] |           | No     | Ring cutters          | -                                                                           | Residual stiffness, residual sensory disturbance |
| Rohilla et al. [25] | Local      |        | Ring cutters          | -                                                                           | Normal                                       |
| Saltz et al. [26]   | Local      | Yes    | Wire cutters          | -                                                                           | -                                           |
| Shafiroff [27]      | General    | No     | Ring cutters          | -                                                                           | -                                           |
| Sleilati et al. [28] | General    |        | -                    | -                                                                           | Return of normal sensation, restricted ROM   |
| Uemura et al. [29]  | Regional   | Yes    | None required         | Ruptured FDP, compressed NVB: patient refused repair                       | Return of normal sensation, restricted ROM   |
| Unlü et al. [30]    |            |        | Neovascularisation    | -                                                                           | Residual stiffness                            |
| Witt [31]           |            | Yes    | Ring cutters          | -                                                                           | Residual stiffness                            |
| Woodhouse [32]      | General    | Yes    | -                    | Partially ruptured FDS: no repair                                         | Return of normal ROM                         |

**TABLE 3: Reported intraoperative data**

NVB, neurovascular bundle(s); ROM, range of movement; FDP, flexor digitorum profundus; FDS, flexor digitorum superficialis

Note: Unrecorded data are represented by ‘-’.

Twenty authors reported follow-up findings at varying lengths of time postoperatively. Six patients had an improvement in their interphalangeal joint ROM/stiffness, whilst 12 showed no improvement at follow-up. Three patients had an improvement in their sensibility, whilst three had residual sensory disturbance.

The term ‘embedded ring syndrome’ has previously been used to describe the association of this injury with psychiatric illness [5]. Initial case reports in the literature pointed towards a prerequisite of mental illness to develop an embedded ring; however, as shown in our review, it is not an absolute requirement; 25% of...
patients were confirmed to have no mental illness.

All three of the paediatric cases had radiographic evidence of the ring eroding into the proximal phalanx [9,23,31]. A possible explanation for this unusual phenomenon may be that as the ring embeds, the child's finger continues to grow, and the embedded ring is encompassed into the growing bone. These cases also highlight that there may be delays in presentation and diagnosis, owing to the child's lack of insight or sense of deep embarrassment [9].

Adult cases with evidence of bony erosion reported a long duration of symptoms (9 years, 10 years and 31 years), supporting the suggestion that chronicity increases the risk of bony involvement [14-15,29]. A 17-year-old patient was found to have an embedded ring in her proximal phalanx, with a reported symptom duration of three months; this time period may have been shortened since the patient had not reached skeletal maturity [16]. We recommend that radiographs are indicated when presented with an embedded ring injury, firstly, to identify any bony involvement and, secondly, to detect any hidden rings that may not be identified on clinical examination [9,28].

There was a clear history of a causative event in 35.7% (n=10) of patients, and the most common history was one of a traumatic insult adjacent to the ring. It could logically follow that traumatic disruption of the epithelium combined with the chronic circumferential constriction of a ring provides an opening through which the ring can ulcerate down the subcutaneous layer to the bone. Reepithelialisation then occurs atop the ring. Almost all cases reported digital swelling. This is secondary to the mechanical obstruction of the ring causing venous congestion and disruption to lymphatic drainage [17]. Given the chronicity of symptoms and confounding psychiatric factors, it is likely that small traumatic events to the finger are underreported by the patient.

Two authors reported delayed capillary refill times, but there was no evidence of ischaemic necrosis in any patient, and none required amputation. The embedded ring is a rigid metal structure and is not collapsible; indeed, patients present with rings that have been embedded for many years but show no sign of vascular compromise. This is in contrast to a collapsible structure that acts as a tourniquet, such as in hair tourniquet syndrome [33]. However, the sample size of 28 patients is too small to draw a definitive conclusion that embedded rings do not lead to ischaemia. Additionally, given the thicker periosteum and open physis, the risk of ischaemia cannot be dismissed in a paediatric patient as growth occurs, which may result in the occlusion of neurovascular structures.

The majority of patients underwent surgical ring removal and primary closure, without documentation as to whether neurovascular bundles and tendons were visualised. Given that a majority of patients (71.4%, n=20) presented with reduced range of movement (which persisted at follow-up), it is possible that tendon damage was present but not visualised.

Only one author performed operative repair; tenolysis and tenosynovectomy were performed after finding ruptured flexor and extensor tendons [20]. Regarding the neurovascular bundle, compression of the bundle was the only adverse finding reported on this structure [29]. The sensory disturbance that results from the embedded ring is likely due to neuropraxia secondary to oedema and direct pressure on the nerve from the adjacent ring.

**Learning points**

1. When there is any traumatic injury adjacent to a ring, the ring should be removed until the injury has healed.

2. Ischaemia is unlikely to be a feature of embedded ring injuries; however, available data are sparse and a theoretical risk still exists.

3. Embedded rings are not exclusive to the psychiatric population.

4. Radiographs should always be obtained in embedded ring injuries to identify bony involvement and hidden rings not visible on clinical examination.

**Conclusions**

Embedded ring injuries are rare. Consequently, information is sparsely available regarding its natural history and management. The hand surgeon's approach requires an understanding that the chronicity of these injuries can have a significant traumatic impact on the structures of the finger.

The responsible healthcare professional should consider the patient's mental health status when determining whether wound exploration and structural repair should be performed. A discussion should be had with the patient regarding the possibility of tendon or nerve repair in addition to ring removal to identify the patient's expectations. Given the preponderance of psychiatric diagnoses in the embedded ring...
injury population, clear treatment goals should be identified.

**Additional Information**

**Disclosures**

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