J. Maxillofac. Oral Surg. (Apr–June 2019) 18(2):180–189
https://doi.org/10.1007/s12663-018-1139-7

REVIEW PAPER

Systematic Review of Lesser Known Parasitoses: Maxillofacial Dirofilariasis

Kirti Chaudhry[1] · Shruti Khatana[2] · Naveen Dutt[3] · Yogesh Mittal[4] · Shailja Sharma[5] · Poonam Elhence[6]

Received: 26 February 2018 / Accepted: 25 July 2018 / Published online: 2 August 2018

Abstract
Background Dirofilariasis is an endemic disease in tropical and subtropical countries caused by about 40 different species of dirofilari. Dirofilariasis of the oral cavity is extremely rare and is usually seen as mucosal or submucosal nodules. We also present a case of dirofilariasis of the mandibular third molar region submucosally in a 26 year old male patient.
Purpose To identify, enlist and analyze the cases of dirofilariasis in maxillofacial region reported worldwide so as to understand the clinical presentation and encourage the consideration of helminthic infections as a possible differential diagnosis in maxillofacial swellings.
Methods Two authors KC and SK independently searched the electronic database of PUBMED, OVID, Google Scholar and manual search from other sources. A general search strategy was planned and anatomic areas of interest identified. The search was made within a bracket of 1 month by the independent authors KC and SK who assessed titles, abstracts and full texts of articles based on the decided keywords. The final selection of articles was screened for the cases that were reported in the maxillofacial region including the age, gender, site of occurrence and region of the world reported in. A geographic distribution of the reported cases was tabulated.
Results A total number of 265, 97, 1327, 3 articles were identified by PubMed, Ovid, GoogleScholar and manual search respectively. The final articles were manually searched for duplicates and filtered according to the inclusion/exclusion criteria which led to a final list of 58 unique articles that were included in the study. In total 99 cases were identified.
Conclusion Although intraoral dirofilarial infections are extremely uncommon, it should be considered in the differential diagnosis of an intraoral or facial swelling that does not completely respond to routine therapy especially in patients from endemic areas.

Keywords Dirofilariasis · Maxillofacial · Parasitosis · Diro · Filariasis

✉ Shruti Khatana
shru.k85@gmail.com

Kirti Chaudhry
chaudhry_kirti@yahoo.com

Naveen Dutt
kirti_chaudhry@gmail.com

Yogesh Mittal
dryogesh82@gmail.com

Shailja Sharma
shailjachambial@yahoo.com

Poonam Elhence
drpoonamelhence@gmail.com

[1] Department of Dentistry, AIIMS Jodhpur, Jodhpur, India

[2] Maxillofacial Surgery (Trauma & Emergency), AIIMS Jodhpur, Jodhpur, India

[3] Department of Pulmonary Medicine, AIIMS Jodhpur, Jodhpur, India

[4] Department of Maxillofacial Surgery, Jodhpur Dental College, Jodhpur, India

[5] Department of Biochemistry, AIIMS Jodhpur, Jodhpur, India

[6] Department of Pathology, AIIMS Jodhpur, Jodhpur, India

Introduction

Dirofilariasis is an endemic disease in tropical and subtropical countries caused by about 40 different species of Dirofilaria [1]. Dirofilaria is primarily confined to animals such as dogs, cats, foxes, raccoons and other wild animals which act as their definitive hosts. Humans are accidental or dead-end host and are infected by less than six species of Dirofilaria that too most commonly by *Dirofilaria repens* and *Dirofilaria immitis* [2].

Dirofilaria infection in humans characteristically manifests as a strong inflammatory reaction in the surrounding tissues and may have a varied clinical presentation depending on the site of infestation. Dirofilariasis of the oral cavity is extremely rare and is usually seen as mucosal or submucosal nodules. We present a case of dirofilariasis of the mandibular third molar region submucosally in a 26-year-old male patient.

Case Report

A 26-year-old male patient reported with a complaint of recurrent episodes of pain and swelling over the right side of lower face to the Department of Dentistry, All India Institute of Medical Sciences, Jodhpur, Rajasthan. Patient had three episodes of pain and swelling over the duration of 6 months. Extra orally, diffuse swelling of the right cheek was noted without any paresthesia. No cervical or generalized lymphadenopathy was present. Intraorally, pericoronitis and pus discharge around impacted right lower third molar were found (Fig. 1). An orthopantomograph revealed a distoangular impacted mandibular third molar with a small cystic radiolucency around the tooth (Fig. 2). Considering pericoronitis, surgical removal of third molar was planned under local anesthesia and antibiotics. During mucoperiosteal flap reflection, complete loss of periosteum with significant induration of the flap and slight erosion of underlying bone was seen. Suspecting some abnormal mass, procedure was deferred, an incisional biopsy was performed and specimen was sent for histopathological

Fig. 1 Intraoral view

Fig. 2 OPG view showing bone erosion distal to 48

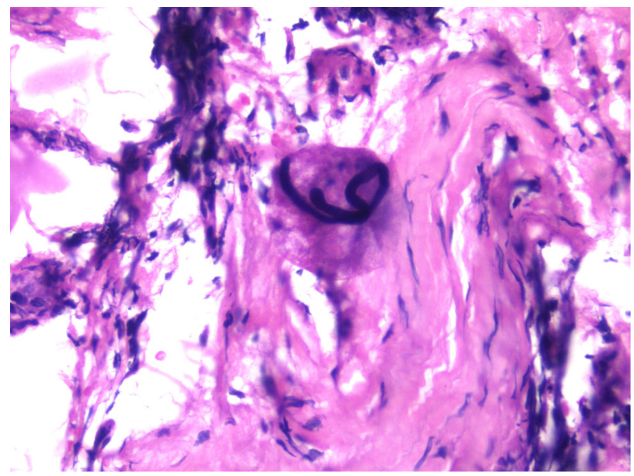


Fig. 3 Histopathological report showing profile of a single coiled unsheathed nematode within fibrocartilaginous tissue

examination. Microscopic examination revealed edematous and inflamed granulation tissue with a profile of a single coiled unsheathed nematode within fibrocartilaginous tissue suggestive of Dirofilaria (Fig. 3).

Patient's chest X-ray ruled out any "coin lesions," which characterize the lymphatic spread to lungs. Blood investigations revealed slightly raised erythrocyte sedimentation rate without any eosinophilia. Under antibiotic coverage, surgical removal of impacted right third molar along with excision of remaining inflamed granulation tissue around third molar was done. Antihelminthic drugs diethylcarbamazine (DEC) 100 mg thrice a day for three weeks, albendazole 400 mg once a day for 1 week and single dose of tablet ivermectin 12.5 mg were prescribed. Patient is on a regular follow-up since 36 months and is completely asymptomatic.

Aim

To identify, enlist and analyze the cases of dirofilariasis in maxillofacial region reported worldwide so as to understand the clinical presentation and encourage the consideration of helminthic infections as a possible differential diagnosis in maxillofacial swellings.

Materials and Methods

Two authors KC and SK independently searched the electronic database of PUBMED, OVID, Google Scholar and manual search from other sources. A general search strategy was planned, and anatomic areas of interest identified. There was no time bracket limitation for the search. The inclusion/exclusion criteria were identified as follows:

Inclusion Criteria

- Cases diagnosed histopathologically or serologically as Dirofilaria
- Cases in maxillofacial region in human beings only
- Details of case available
- English language/translated articles only

Exclusion criteria

- Nematodes other than Dirofilaria
- Non-human cases
- Non-English language/translated articles only
- Sites other than maxillofacial region or site details not available

The search was made within a bracket of 1 month by the independent authors KC and SK who assessed titles, abstracts and full texts of articles based on the following keywords: maxilla, mandible, jaw, zygomatic, zygoma, zygomaticotemporal, zygomatico-temporal, palate, palatal, subcutaneous, submucosal, dermal, face, facial, maxillofacial, oral cavity, mouth, cheek, buccal mucosa, buccinators, tongue, medial pterygoid, lateral pterygoid, pterygoid, masseter, temporalis, gum, gingiva, lip, parotid, submandibular, lingual, sublingual, nasolabial, labial, infraorbital with Dirofilaria, diro, dirofilariasis, helminth, nematode, and humans.

Titles that did not get excluded based on the exclusion criteria were selected for assessment of abstract or full text. Any disagreement was discussed on, and final selection made based on the inclusion and exclusion criteria. In addition, references of review articles were used as a retrospective database for articles which were manually handsearched.

The final selection of articles was screened for the cases that were reported in the maxillofacial region including the age, gender, site of occurrence and region of the world

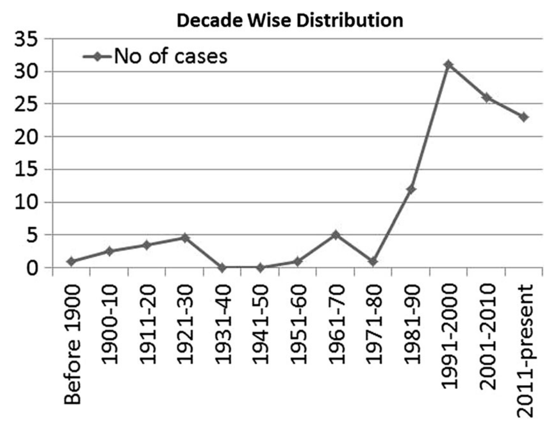


Fig. 5 Year wise distribution

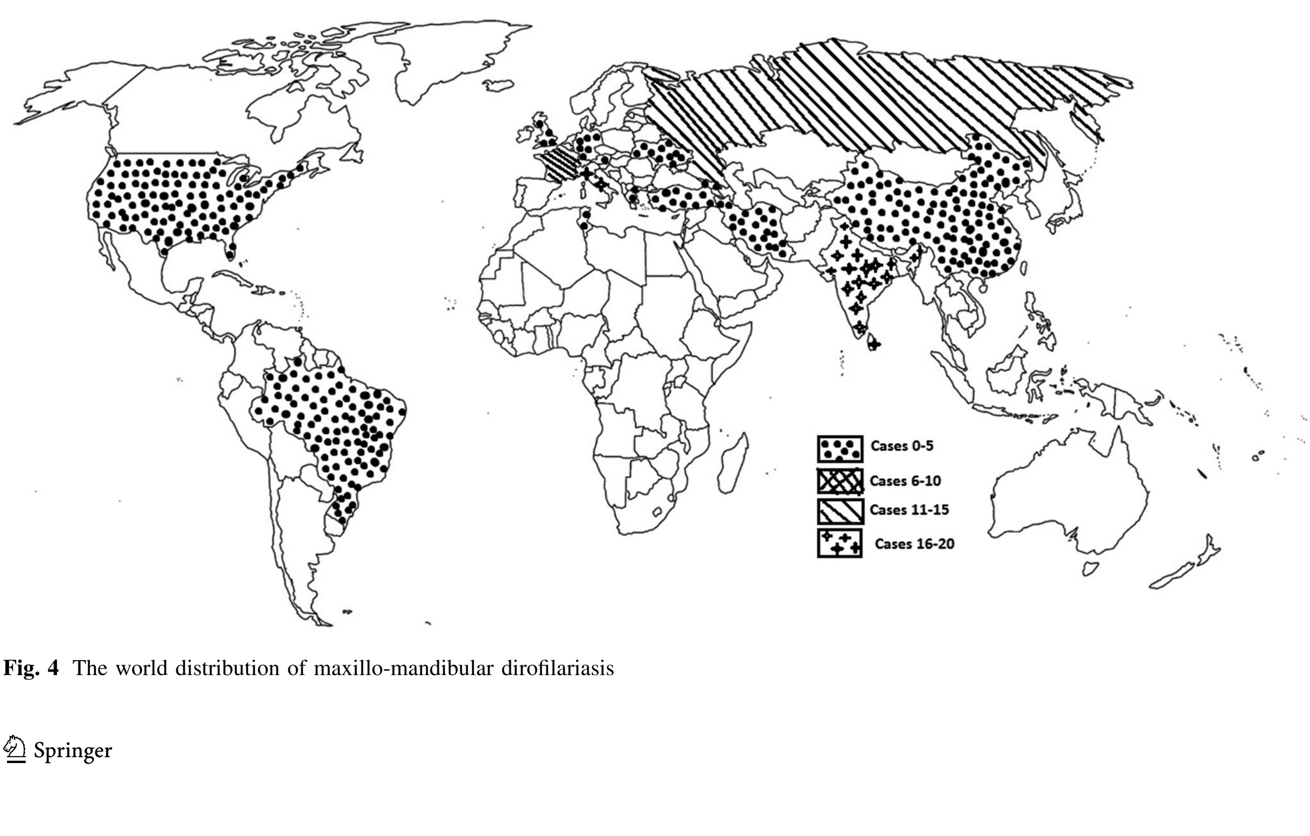
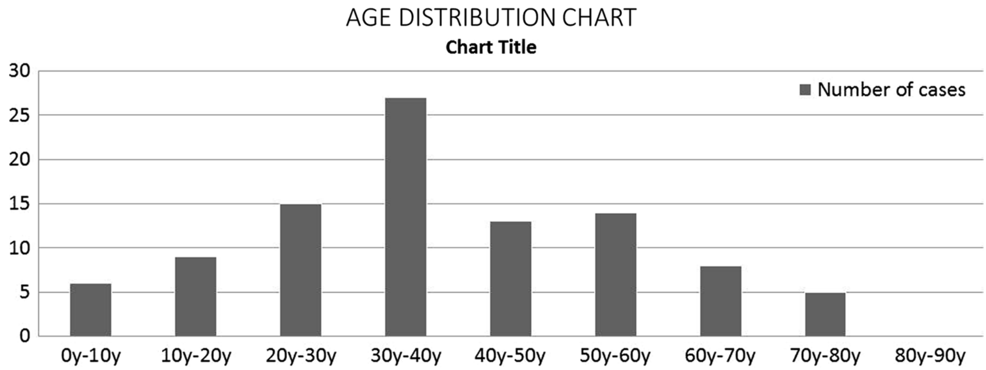


Fig. 4 The world distribution of maxillo-mandibular dirofilariasis

Fig. 6 Age affected



reported in. A geographic distribution of the reported cases was tabulated (Figs. 4, 5, 6, 7).

Results

Paper Selection

A total number of 265, 97, 1327 and 3 articles were identified by PubMed, Ovid, Google Scholar and manual search, respectively. The final articles were manually searched for duplicates and filtered according to the inclusion/exclusion criteria which led to a final list of 58 unique articles that were included in the study (Fig. 8).

Details

We checked the references of these articles for other cases and thoroughly studied them. Non-English literature has not been included in our review. Reviews by Avdiukhina et al. [3] and Ilyasov et al. [4] helped us to include cases published in Russian language journals in our review. We could incorporate articles published in French to our review, consulting reviews by Pampiglione [5, 6]. The last search was carried out on January 30, 2018.

In total, we found 99 cases of Dirofilaria affecting the maxillo-mandibular region in literature and the present case is the 100th one.

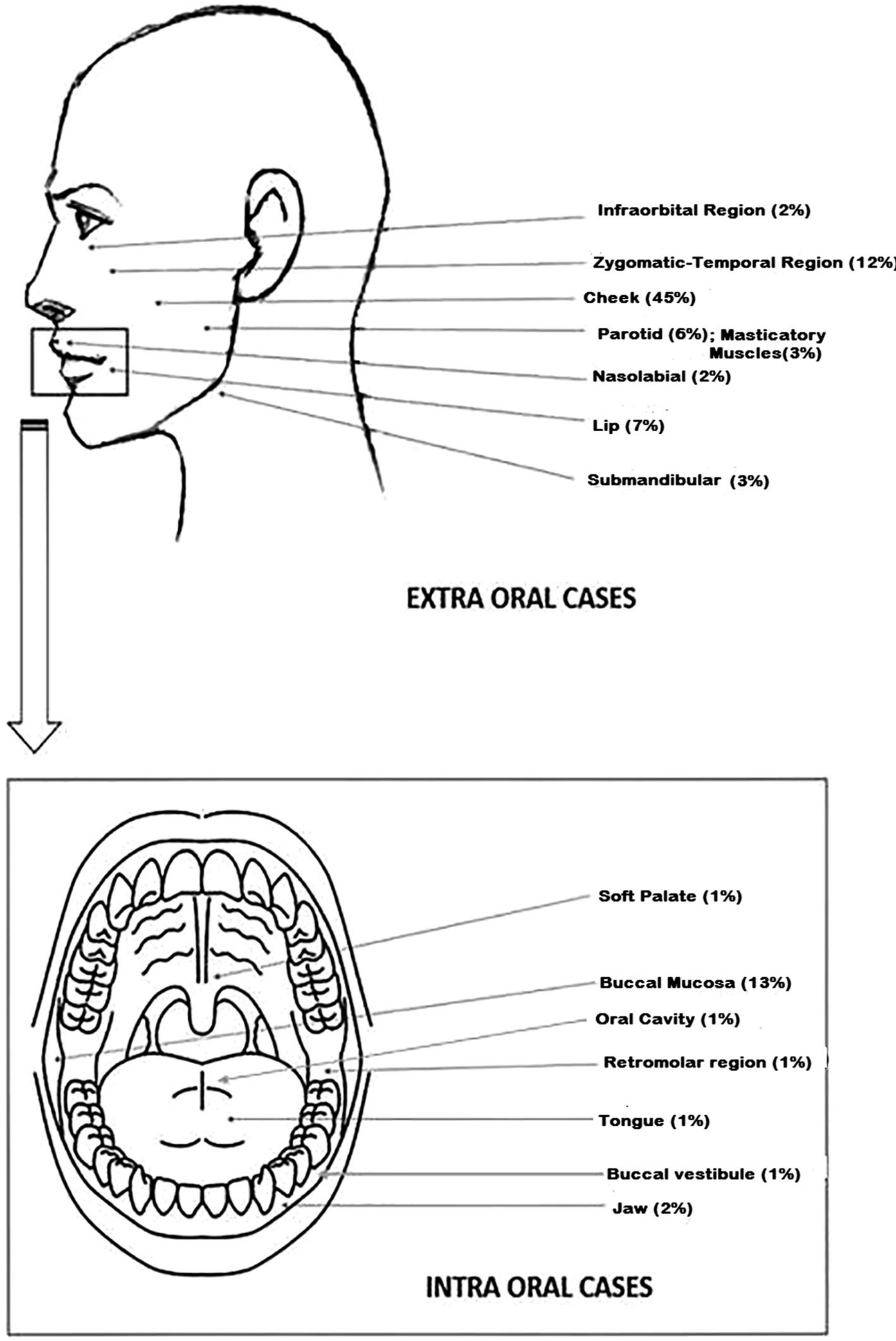
Results and Discussion

The habitual hosts are infected after a bite by various arthropods which are biological carriers and serve as intermediate hosts and can transmit it to humans during their subsequent meals [7]. In India, dog population is estimated to be around 25 million [8] An Indian study from Southern India reported blood smear from 7.59% of dogs to be positive for Dirofilaria [9]. In another survey, 16.7% of dogs in Mumbai were shown to be infected with *Dirofilaria repens* and 4.5% of dogs in Delhi were infected with *Dirofilaria immitis* [10]. This suggests that humans are at a higher risk of acquiring Dirofilaria infection from dogs.

Humans are the dead-end host where Dirofilaria develops into an unmated worm that neither reproduces nor releases microfilariae. Human-to-human and human-to-arthropod transmission, thus does not occur [7]. Dirofilaria reaches human through an insect bite that mostly cannot be recalled by patient and sometimes bite may be recalled as painful followed by slight local acute phlogosis (erythema, swelling and pruritis) lasting for few days. Dirofilaria may even invade the blood stream and may be carried to distant sites like lungs, genitalia, omentum. Finally, Dirofilaria dies and mounts a severe foreign body response and forms nodules which may even suppurate, and the signs and symptoms are in accordance with the site of entrapment.

The first reported case of dirofilariasis was in subconjunctival region in France in a 3-year-old female in 1566. Since then more than 800 cases have been reported, and dirofilariasis is considered as an emerging zoonosis [11, 12]. In this review, we analyzed only the cases of dirofilariasis involving the maxillo-mandibular region and characterized them with regard to geographic, age, gender and affected site distribution. The first reported case of maxillo-mandibular dirofilariasis was in year 1864 in a 20-year-old male patient affecting the lip [13]. There are total 100 reported cases of maxillo-mandibular dirofilariasis till now including the present case. (Table 1). There were barely a few reported cases of maxillo-mandibular dirofilariasis before 1980. After that, there was a sharp increase in the reported cases over the next two decades followed by gradual fall over the next two decades. The maximum number of reported cases was in the time frame of 1991–2000 (31 cases) (Fig. 5). The reason for initial increase in all probability is multifactorial. At least a part of increase in the incidence of the disease may be attributed to the changing climatic conditions (temperature, relative humidity, rainfall and evaporation) that favor the growth of the carrier *culicidae* and also the development of larval phase of nematode inside the carrier [14, 15]. Further, it

Fig. 7 Site distribution



has been postulated that greenhouse effect has further increased the vector population globally causing an increase in vector-borne diseases like malaria, dengue, and dirofilariasis [16].

Clinical diagnosis of dirofilariasis is almost wrong and is usually mistaken for malignancy, cyst, adenoma, hematoma, lipoma, abscess and a wide range of differentials except dirofilariasis. Jelink et al. [67] reported two patients feeling “worm under skin” who were wrongly admitted in psychiatry ward and were later on diagnosed with Dirofilaria. Similarly, one patient was diagnosed with trigeminal neuralgia and was completely relieved after nematode was removed from the bulbar conjunctiva, and it was probably due to Dirofilaria migration to the head [3].

Radical surgeries were thus performed and later on histopathologically diagnosed it to be Dirofilaria. This has led to an increased interest among academicians resulting in greater reporting, hence further increasing the total evidence in the form of published data. Thus, the increase may have been an indirect result of increased awareness

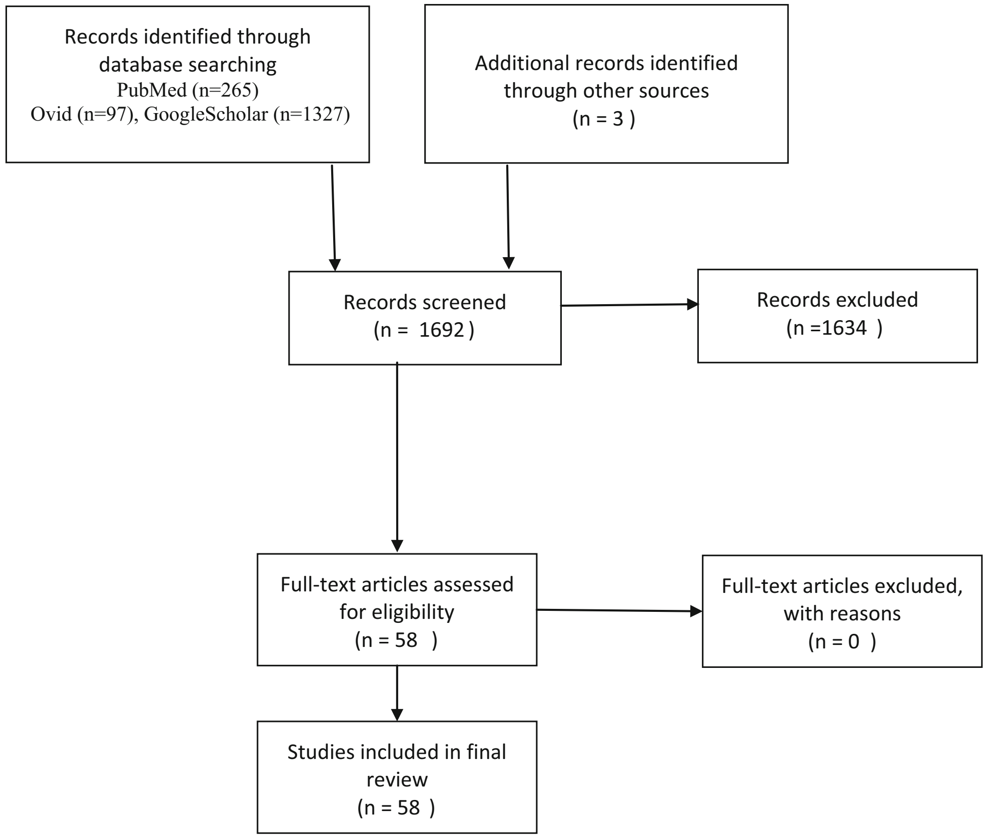


Fig. 8 Prisma diagram

among medical practitioners about Dirofilaria. Technical advancements and increased availability of refined diagnostic aids like use of PAS and Masson–Goldner's trichrome stains and use of biomolecular techniques like PCR assay for phylogenetic analysis further increased the case detection [68]. Thereafter, gradual decrease in reported cases over the last two decades (26 cases in 2001–2010 and 23 in the present decade) could have been due to better vector control.

Previous reviews of dirofilariasis of whole body have shown it to be an endemic disease of primarily third world temperate countries like Italy, France, Russia and Sri Lanka. In the present review also, this holds true as we have found 62 cases in temperate region and 38 cases in tropical countries. Interestingly the number of cases in the tropical countries is increasing significantly over the last 40 years. On the other hand, reported number of cases in temperate countries is showing a sharp downward trend for the last 3 decades. This virtual shift could also be related partly to control of canine vector-borne diseases in European countries (temperate climate). WHO in 2015 has declared Europe malaria-free with one of its modalities being mosquito control [69]. This vector control could have resulted in decline in cases in last two decades in European countries where earlier it was quite rampant. However europe being declared as malaria free due to vector control and its exact influence on incidence of dirofilaria in europe, still needs to be studied better. Our study reflects that India (19%) has topped the list followed by Italy (18%) and Sri Lanka (17%) in the reported number of cases which could be credited to wide range of climatic conditions, huge population density, large rural population, lack of personal hygiene, reduced availability of preventive health-care facilities, abundance of stray animals and vectors, reduced education, awareness among masses and reduced veterinary facilities.

Age distribution of dirofilariasis shows that it can affect any age group. In our review of 100 patients with maxillo-mandibular dirofilariasis, mean age of occurrence is found to be 39.22 years, with a range from 10 months to 80 years. Maximum number of cases has been reported in the fourth decade of life followed by the third decade (Fig. 6). Female preponderance (51%) has been observed in the present review.

In the review published by Pampiglione et al. [6], only 3.4% of total body cases were from the maxillo-mandibular region. Involvement of maxillo-mandibular region is less common with involvement of the oral cavity being even rarer. In the present review, maximum number of cases were reported in cheek (45%) followed by buccal mucosa (13%) and then zygomaticotemporal region (12%). It

Table 1 Area wise distribution

S.NO	Reporting Author/ Ref	Year	Age/Sex	Site
India				
1	Senthilvel [17]	1999	39/F	Lip
2	Padmaja [18]	2005	35/F	Lip
3	Khurana [19]	2010	45/M	cheek
4	Joseph [20]	2010	10/F	Nasolabial
5	Joseph [20]	2010	39/F	Parotid
6	Joseph [20]	2010	24/F	Infraorbital
7	Joseph [20]	2010	45/F	Cheek
8	Permi [21]	2011	40/M	Cheek
9	Souza [22]	2013	28/M	Cheek
10	Nath [23]	2013	30/M	Cheek
11	Kurup [1]	2013	54/F	Buccal mucosa
12	Khyriem [24]	2013	27/F	Cheek
13	Manuel [25]	2014	32/M	Buccal vestibule
14	Janardhanan [26]	2014	54/F	cheek
15	Premakumar [27]	2014	32/M	Cheek
16	Krishna [28]	2015	64/F	Infraorbital
17	Desai [29]	2015	32/M	Buccal mucosa
18	Balaji [30]	2016	19/F	Buccal mucosa
19	Present case	2017	26/M	Retromolar area
Sri Lanka				
20	Attygalle [31]	1966	48/M	Parotid region
21	Dissanaike [32]	1997	3/M	Cheek
22	Dissanaike [32]	1997	10 m/F	Cheek
23	Dissanaike [32]	1997	28/M	Cheek
24	Ratnatunga [33]	1999	*65/F*	Cheek
25	Ratnatunga [33]	1999	45/M	Cheek
26	Pitakotuwage [34]	1999	80/F	Cheek
27	Tilakaratne [35]	2003	26/F	Buccal mucosa
28	Tilakaratne [35]	2003	80/F	Buccal mucosa
29	Tilakaratne [35]	2003	52/F	Buccal mucosa
30	Tilakaratne [35]	2003	28/F	Buccal mucosa
31	Tilakaratne [35]	2003	4/F	Buccal mucosa
32	Tilakaratne [35]	2003	40/F	Buccal mucosa
33	Tilakaratne [35]	2003	53/M	Lip
34	Jayasinghe [36]	2011	57/F	Cheek
35	Jayasinghe [36]	2011	20/M	Cheek
36	Senanayke [37]	2013	11 M/ NS	Cheek
Italy				
37	Pane [13]	1864	20/M	Lip
38	Babudiere [5]	1937	18/M	Cheek
39	Colla [5]	1967	71/M	Cheek
40	Colla [5]	1967	54/F	Cheek
41	Bianchi [5]	1968	20/M	Zygomatic
42	Fruttaldo [5]	1985	40/M	Zygomatic
43	Fruttaldo [5]	1985	44/M	Zygomatic
44	Toniolo [5]	1987	23/M	Jaw
45	Bertiato [5]	1987	25/M	Mandibular
46	Pampiglione [5]	1988	37/F	Cheek
47	Pampiglione [38]	1993	53/M	lip
48	Maccioni [5]	1994	38/M	Zygomatic
49	Pampiglione [6]	1996	38/M	Zygomatic
50	Pampiglione [39]	1996	43/F	Temporalis
51	Cancirini [40]	1998	59/M	Submandibular lymph node
52	Pampiglione [6]	1999	39/M	Zygomatic
53	Pampiglione [6]	1999	27/F	Cheek
54	Pampiglione [6]	1999	4/M	Cheek
Russia				
55	Maximova [41]	1991	41/F	Zygomatic
56	Avdiukhina [3]	1993	35/M	Submandibular
57	Postnova [42]	1997	33/F	Cheek
58	Postnova [42]	1997	31/M	Cheek
59	Postnova [42]	1997	18/F	Cheek
60	Postnova [42]	1997	35/F	Soft palate
61	Avdiukhina [3]	1997	55/F	Lip
62	Laura [43]	2007	23/F	Oral cavity
63	Laura [43]	2007	43/F	Cheek
64	Ilyasov [4]	2014	32/F	Cheek
65	Ilyasov [4]	2014	38/F	Zygomatic
66	Ilyasov [4]	2014	30/F	Parotid
Greece				
67	Triantafillopoulos [44]	1952	26/F	Cheek
68	Markopoulos [45]	1990	48/F	Cheek
69	Auer [46]	1997	NS	Parotid
70	Tzanetou [47]	2009	45/F	Cheek
France				
71	Quilici [5]	1982	35/F	Zygomatic
72	Quicili [5]	1983	19/M	Cheek
73	Lapierre [48]	1982	42/M	Cheek
74	Quicili [5]	1986	50/M	Zygomatic
75	Quicili [5]	1987	47/M	Cheek
76	Quicili [5]	1991	38/F	Zygomatic
77	Quicili [5]	1993	29/M	Cheek
78	Quicili [5]	1993	56/M	Cheek
79	Weill [6]	1999	66/M	Cheek
80	AbouBacar [49]	2007	35/M	Cheek
81	Rivière [50]	2014	52/F	Intramasseteric
Turkey				
82	Latifoğlu [2]	2002	62/M	Premasseteric mass
China				
83	Tsang [51]	2003	42/F	Buccal mucosa
Britain				

Table 1 continued

S.NO	Reporting Author/ Ref	Year	Age/Sex	Site
84	Seddon [52]	1992	12/M	Parotid
85	Ahmed [53]	2010	32/M	Parotid
Tunisia				
86	Kaouech [54]	2010	40/F	Lip
Germany				
87	Friedrich [55] Zygomaticotemporal	2014	40/F	
Brazil				
88	Pereira [56]	2015	65/F	Buccal mucosa
89	Daroit [57]	2016	65/F	Buccal mucosa
United States of America				
90	Collins BM [58]	1992	53/M	Cheek
91	AJ Herzberg [59]	1995	66/M	Cheek
92	Akst LM [60]	2004	73/F	Cheek
93	VélezPérez [61]	2016	79/M	Buccal mucosa
Iran				
94	Maraghi [62]	2006	34/M	Cheek
95	Radmanesh [63]	2006	31/M	Nasolabial
Austria				
96	Fuehrer [64]	2000	59/M	Cheek
97	Fuehrer [64]	2008	62/F	Cheek
98	Barbara Bockie [65]	2009	52/M	Cheek
Ukraine				
99	Enghelestein [66]	1973	17/F	Submandibular
Georgia				
100	Zenaishvili [5]	1983	28/F	Tongue

seems that as these are the most prominent areas on the face for mosquito bite, Dirofilaria gets inoculated here, migrates and localizes in deeper tissues.

For the diagnosis of dirofilariasis, a suggestive patient history and clinical examination are important clues. Microscopic examination of the removed parasites or their fragments remains the golden standard to confirm the diagnosis. It becomes increasingly difficult for histopathologists to correctly diagnose the nematode when it is in the advanced stage of decomposition [70].

The definitive treatment of Dirofilaria infection in humans is surgical removal of the adult worm. If difficulty is encountered in surgical removal of the worm because of the excessive movement, a cryoprobe can be used for immobilizing it as described by Geldelman [71]. Medication such as diethylcarbamazine (DEC), ivermectin and albendazole is routinely administered. DEC (2 to 4 mg/kg body weight over a period of 4 weeks) is highly specific for microfilaria as it alters its membrane so that they are easily phagocytized by tissue-fixed monocytes. Albendazole is of adjuvant value in treating filariasis [72]. Ivermectin, a broad spectrum antiparasitic drug, blocks the transmission of microfilariae and can be administered as a single oral dose annually without any side effects [73].

Effective way of control of this parasitosis is basically adoption of proper vector control and increasing patient awareness. However, administrating prophylactic dose of ivermectin ($>$ 6 µg/kg once a month for 7 consecutive months) to the canines in the endemic areas has also been proposed [73].

Conclusion

Although intraoral Dirofilaria infections are extremely uncommon, it should be considered in the differential diagnosis of an intraoral or facial swelling that does not completely respond to routine therapy especially in patients from endemic areas. This study was aimed toward an extensive data analysis of incidence, age distribution and country distribution of dirofilariasis in the world, so as to allow for a better understanding of pattern of maxillofacial dirofilariasis. In our opinion, there has not been much literature study in regard to maxillofacial dirofilariasis exclusively, making it a less likely candidate in differential diagnosis. The study aims to increase awareness of this amid medical professionals. Medical awareness of the risk of the infection is essential, and very often, a detailed history (including travel) is helpful in diagnosis. Many of them remain undiagnosed or unreported. Hence, it is emphasized that surgeon should have an increased awareness about this infection. This study could also serve to draw attention toward organized programs for elimination of the zoonotic disease from dogs and other reservoir hosts.

Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest.

Human and animal rights All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Kurup S, Veeraraghavan R (2013) Filariasis of the buccal mucosa: a diagnostic dilemma. Contemp Clin Dent 4:254–256
2. Latifoglu O, Zmen S, Sezer C (2002) Dirofilaria repenspresenting as a premasseteric nodule. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 94:217–220

3. Avdiukhina TI, Supriaga VG (1997) Dirofilariasis in the Community of Independent States countries: analysis of cases from 1915 to 1996. MedskParazitol 4:3–7
4. Ilyasov B et al (2015) Thirty cases of human subcutaneous dirofilariasis reported in Rostov-onDon (Southwestern Russian Federation). Enferm Infecc Microbiol Clin 33:233–237
5. Pampigilone S, CanestriTrotti G (1995) Human dirofilariasis due to Dirofilaria (Nochtiella) repens: a review of world literature. Parassitologia 37:149–193
6. Pampiglione S, Rivasi F (2000) Human dirofilariasis due to Dirofilaria (Nochtiella) repens: an update of world literature from 1995 to 2000. Parassitologia 42:231–254
7. Orihel TC (1969) Dirofilariacorynodes(VonLinstow, 1899): morphology and life history. J Parasitol 55:94–103
8. Megat et al (2010) Canine vector-borne diseases in India: a review of the literature and identification of existing knowledge gaps. Parasites Vectors 3:28
9. Sabu L, Devada K, Subramanian H (2005) Dirofilariosis in dogs and humans in Kerala. Indian J Med Res 121:691–693
10. Megat Abd Rani PA, Irwin PJ, Gatne M et al (2010) A survey of canine filarial diseases of veterinary and public health significance in India. Parasit Vectors 3:30
11. Munro A et al (1999) Human dirofilariasis in the European Union. Parasitol Today 15:386–389
12. Nadgir S et al (2001) Sunconjunctival dirofilariasis in India. Southeast Asian J Trop Med Public Health 32:244–246
13. Pane C (1864) No ta su un elminto nematoide. Ann Acad Aspiranti 4:32–34
14. Martin PH, Lefebvre MG (1995) Malaria and climate: sensitivity of malaria potential transmission to climate. Ambio 24:200–207
15. Genchi C, Rinaldi L, Mortarino M et al (2009) Climate and Dirofilaria infection in Europe. Vet Parasitol 163:286–292
16. Harvell CD et al (2002) Climate warming and disease risks for terrestrial and marine biota. Science 296:2158–2162
17. Senthilvel K et al (1999) A case of subcutaneous dirofilariasis in a woman in Kerala. Ind Vet J 76:263–264
18. Padmaja P et al (2005) Subcutaneous dirofilariasis in Southern India: a case report. Ann Trop Med Parasitol 99:437–440
19. Khurana S, Singh G (2010) Human subcutaneous dirofilariasis in India: a report of three cases with brief review of literature. Ind J Med Microbiol 28:394–396
20. Joseph E, Matthai AA et al (2010) Subcutaneous human dirofilariasis. J Parasit Dis 35:140–143
21. Permi HS, Kishan et al (2011) Subcutaneous human dirofilariasis due to Dirofilariarepens: report of two cases. J Glob Infect Dis 3:199–201
22. D'Souza R, Jakribettu RP et al (2013) Subcutaneous nodule: a case of Dirofilaria. Int J App Basic Med Res 3:64–65
23. Nath R, Bhuyan S, Dutta H, Saikia L (2013) Human subcutaneous dirofilariasis in Assam. Trop Parasitol 3:75–78
24. Khyriem AB, Lynrah KG, Lyngdoh WV (2013) Subcutaneous dirofilariasis. Indian J Med Microbiol 31:403–405
25. Manuel S, Surej LK, Khalam SA (2015) Oral dirofilariasis: report of a case arising in the buccal vestibular region. J Oral Maxillofac Surg Med Pathol 27:418–421
26. Janardhanan M, Rakesh S, Savithri V (2014) Oral dirofilarasis. Indian J Dent Res 25:236–239
27. Premakumar P, Nair V, Nair B, Thomas S (2014) Discussion of a case of Dirofilariasis presenting as a nodular mass. Int J Medical Health Sci 3:223–225
28. Krishna AS, Bilahari N, Savithry (2015) Subcutaneous infraorbitaldirofilariasis. Indian J Dermato 60:420
29. Desai RS, Pai N, Singh JS (2015) Oral dirofilariasis. Indian J Med Microbiol 33:593–594
30. Balaji SM (2014) Live dirofilaria in buccal mucosa. Indian Journal of Dental Research 25:546–547
31. Attygalle D, Dissanaike AS (1970) The third case of human infection with dirofilaria sp. from Ceylon. HD Srivastava Commemvolume Izatnagar 453–454
32. Dissanaike AS, Abeyewickreme W, Wijesundera MD (1997) Human dirofilariasis caused by dirofilaria (Nochtiella) repens in srilanka. Parassitologia 39:375–382
33. Ratnatunga N, Wijesundera MS (1999) Histopathological diagnosis of subcutaneous Dirofilariarepens infection in humans. Southeast Asian J Troop Med Public Health 30:370–375
34. Pitakotuwage TN, Mendis BR, Edirisinghe JS (1999) Dirofilaria repens infection of the oral mucosa and the cheek. A case report. Dental Symposium Sri Lanka. RJ–CA: 125
35. Tilakaratne WN, Pitakotuwage TN (2003) Intra-oral Dirofilariarepens infection: report of seven cases. J Oral Pathol Med 32:502–505
36. Jayasinghe RD, Gunawardane SR, Sitheeque MM (2015) A Case Report on Oral Subcutaneous Dirofilariasis. Case Rep Infect Dis. Article Id 648278, 1–4
37. Senanayke MP, Infaq ML (2013) Ocular and subcutaneous dirofilariasis in a Sri Lankan infant: an environmental hazard caused by dogs and mosquitoes. Paediatr Int Child Health 33:111–112
38. Pampiglione S, Fruttaldo L, Canestri TG (1993) Human dirofilariasis: extraction of the living nematode from the upper lip. Pathologica 85:515–519
39. Pampiglione S, Cagno MC, Savalli E, Guidetti F (1996) Human muscle dirofilariasis of difficult diagnosis. Pathologica 88(2):97–101
40. Cancrini G, Favia G, Merulla R et al (1998) Traditional and innovative tools to diagnose 8 new cases of human dirofilariosis occurred in Italy. Parassitologia 40:24
41. MaximovaT Bogachkina SI, Oshevskaya EA (1991) Human nematodoses in Tula region. Kollekt Avtorov 55:56
42. Postnova VF et al (1997) Dirofilariasis in man new cases. Medsk Parazitol 1:6–9
43. Laura H et al (2007) Human Subcutaneous Dirofilariasis. Russia Emerg Infect Dis 13:150–152
44. Triantafillopoulos E (1952) A case of human infection with Nematode in Messinia. Arch iatr Epist 8:58–59
45. Markopoulos AK, Trigonidis G, Papanayotou P (1990) Submucous dirofilarriasis involving cheek. Report of a case. Ann Dent 49:34–35
46. Auer H et al (1997) Einseltener Falleiner Dirofilariarepens infestation des Nebenhodens. Mitt ÖsterrGesTropenmed Parasitol 19:53–58
47. Tzanetou K, Gogou C, Giannoulopoulos A et al (2009) Fibrous subcutaneous nodule caused by Dirofilaria repens. Travel Med Infect Dis 7:318–322
48. Lapierre J et al (1982) Dirofilariasis in humans. Report of a case with localization in the cheek. Sem Hop 24(58):1575–1577
49. Abou-Bacar A, Diallo M, Waller J, Cribier B, Candolfi E (2007) Human subcutaneous dirofilariosis due to Dirofilariarepens. A case diagnosed in Strasbourg, France. Bull SocPathol Exot 100:269–270
50. Rivière D, Vatin L, Morvan J-B, Cathelinaud O (2014) Dirofilariose intramassétérine. Ann Otolaryngol Chir Cervicofac 131(6):379–380
51. EW, Tsang WM, Chan KF. Human dirofilariasis of the buccal mucosa: a case report. Int J Oral Maxillofac Surg. 2003;32: 104-106
52. Seddon SV, Peckitt NS, Davidson RN, Sugar AW (1992) Helminth infection of the parotid gland. J Oral Maxillofac Surg 50(2):183–185
53. Ahmed A, Cascarini L, Goodman A et al (2010) Cutaneous dirofilariasis affecting the parotid duct: a case report. Maxillofacial 10:107–109

54. Kaouech E, Becheur M, Cheikh M (2010) Subcutaneous dirofilariasis of the upper lip in Tunisia Sante 20:47–48
55. Reinhard E, Friedricha, Max H (2014) Human Dirofilariarepens infection of the zygomatico-temporal. J Cranio-Maxillofac Surg 42:612–615
56. Pereira LL, Monteiro LC (2015) Dirofilariasis involving the oral cavity: report of the first case from South America. Rev Soc Bras Med Trop 48:361–363
57. Daroit NB et al. (2016) Submucosal nodule in buccal mucosa. Oral Surg Oral Med Oral Pathol Oral Radiol. pii: S2212–4403
58. Collins BM, Jones AC, Jimenez F (1993) Dirofilariatenuis infection of the oral mucosa and cheek. J Oral Maxillofac Surg 51:1037–1040
59. Herzberg AJ et al (1995) Subcutaneous Dirofilariasis in Collier County, Florida, USA. Am J Surg Pathol 19(8):934–939
60. Akst LM et al (2004) Dirofilarial infection presenting as a facial mass: case report of an emerging zoonosis. JAm J Otolaryngol 25:134–137
61. Vélez-Pérez A et al. (2016) Dirofilariasis Presenting as an Infiltrative Mass in the Right Buccal Space. Int J Surg Pathol
62. Maraghi S et al (2006) Human dirofilariasis due to dirofilaria repens in ahvaz—iran: a report of three cases. Pak J Med Sci 22:211–213
63. Radmanesh M, Saberi A, Maraghi S, Emad-Mostowfi N, Radmanesh M (2006) Dirofilaria repens: a dog parasite presenting as a paranasal subcutaneous nodule. Int J Dermatol 45:477–478
64. Fuehrer HP et al. Dirofilaria in humans, dogs, and vectors in Austria (1978–2014)—from imported pathogens to the endemicity of dirofilaria repens. PLOS Negl Trop Dis. https://doi.org/10.1371/journal.pntd.0004547
65. Böckie BC, Auer H, Sepp NT (2010) Danger lurks in the Mediterranean. Lancet 11(37):2040
66. Enghelshtein AS, Zaporozhets GI (1973) A case detection of Dirofilaria repens. Medskaya Parazit 42:358
67. Jelinek T, Hillen J, Loscher T (1996) Human dirofilariasis. Int J Dermatol 35:872–875
68. Favia G (2000) Molecular diagnosis of Dirofilaria repens is not a dream. Letter to the editor. Diagn Microbiol Inf Dis. 37: 81
69. Regional Strategy (2015) From Malaria Control to Elimination in the WHO European Region 2006–2015. World Health Organization Regional Office for Europe Copenhagen 1–50
70. Pampiglione S, Trotti G (1999) Pitfalls and difficulties in histological diagnosis of human dirofilariasis due to Dirofilaria (Nochtiella) repens. Microbiol, Infect Dis 34(1):57–64
71. Geldelman D, Blumberg R, Sadun A (1984) Ocular Loa Loa with cryoprobe extraction of subconjunctival worm. Ophthalmology 91:300–303
72. Van den Ende J et al (1995) Subcutaneous dirofilariasis caused by Dirofilaria (Nochtiella) repensin a Belgian patient. Int J Dermatol 34:274–277
73. Marconcini A, Magi M, Contin BH (1993) Efficacy of ivermectin in preventing Dirofilariarepens infestation in dogs naturally exposed to contagion. Parassitologia 35:67–71