

# Intraretinal Foreign Bodies: Surgical Techniques and Outcomes

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**Purpose:** To report the clinical features of eyes with intraretinal foreign bodies (IRFBs) and to evaluate the results of surgical management in these eyes.

**Methods:** Hospital records of 34 eyes of 33 patients with IRFBs were reviewed. All eyes underwent pars plana vitrectomy to remove the foreign bodies using intraocular forceps or by magnetic extraction.

**Results:** All patients were male with mean age of 28±12.3 years and were followed for a mean period of 24.5±2.3 months. The IRFBs were ferromagnetic in 29 (85.3%) cases and were removed using an external magnet in 13 eyes (38.4%) or intraocular forceps in 21 eyes (61.6%). Laser photocoagulation was performed around the IRFB prior to surgery in 7 (20.6%) eyes. Macular pucker and scars developed in 8 (23.5%) eyes and retinal breaks posterior to the sclerotomy were formed in 12 eyes (35.3%) postoperatively. Final visual acuity was 20/40 or better in 12 (35.3%) eyes and 20/200 or better in 23 (67.7%) eyes. Final visual acuity of 20/200 or better had no significant relationship with the site, size, or type of the IRFB or with the interval from trauma to surgery.

**Conclusion:** Despite the complexity of surgical management of IRFBs, anatomic and visual outcomes of vitreoretinal surgery in these cases are generally good. The appropriate route of removal may be determined by the type, size, and site of the IRFB. Removal of magnetic IRFBs using external magnets versus intraocular forceps seems to entail comparable results.

**Keywords:** Intraregional Foreign Body (IRFB); Vitrectomy; Surgical Management

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## INTRODUCTION

Ocular trauma associated with intraocular foreign bodies (IOFBs) is one of the major causes of visual impairment in young individuals. Various reports indicate that 18-41% of all open globe injuries involve at least one IOFB.<sup>1-4</sup>

IOFBs may become embedded in the retina<sup>5-8</sup> posing a challenging situation for

vitreoretinal surgeons. In addition to the general complications of IOFBs, intraretinal foreign bodies (IRFBs) specifically increase the risk of retinal breaks and detachments, choroidal hemorrhage, subretinal fibrosis and macular pucker.<sup>5-8</sup> Despite improvements in surgical instrumentation and techniques, the rate of complications related to removal of IRFBs remains high.<sup>5-8</sup>

Herein, we report the clinical features and outcomes of surgical management for IRFBs at two tertiary referral centers in Iran.

## METHODS

In this retrospective study, we reviewed hospital records of 34 eyes of 33 patients with IRFBs who underwent surgical removal at Labbafinejad Medical Center, Tehran, Iran from September 1993 to August 2002 and at Imam Khomeini Hospital, Ahvaz, Iran from September 2002 to March 2011. Patients with preoperative visual acuity of light perception or better and follow-up duration of at least 6 months were included; severely traumatized eyes were excluded.

Patients were recalled for a comprehensive examination. The following variables were recorded for the purpose of the study: age, gender, cause of trauma, best-corrected visual acuity (BCVA) before and after surgery, relative afferent pupillary defect (RAPD), slit lamp and fundus examination, ultrasound examination when ophthalmoscopy was not possible, foreign body localization based on orbital CT scan, size, site, and type of the foreign body, consequences of retained IRFB including chalcosis and siderosis, time interval between injury and foreign body removal, details of all surgical procedures including technique and complications of IRFB removal, and history of preoperative photocoagulation around the embedded foreign body.

### Surgical Technique

All eyes underwent standard three-port pars plana vitrectomy. Pars plana lensectomy or phacoemulsification was performed in eyes with clinically significant lens opacity with or without intraocular lens implantation. An encircling band (No. 240) was placed anterior to the equator in eyes with attached retina. Eyes with retinal detachment underwent scleral buckling with cryotherapy or endophotocoagulation. Fluid-gas exchange or silicone oil injection (1000 cs) was also used as indicated. In eyes with relatively clear media and attached retina, argon laser photocoagulation was applied around the embedded IRFB preoperatively.

During vitrectomy, special attention was paid to removal of condensed vitreous extending from the entrance site to the impact site of the IRFB. In addition, posterior vitreous detachment was induced and attachments of the posterior cortical vitreous to the capsule surrounding the IRFB were released. To remove the IRFB using intraocular forceps, the fibrotic tissue encapsulating the IRFB was excised and the IRFB was mobilized using a bimanual maneuver. In cases of magnetic foreign bodies, one of the following two methods was applied according to the location of the IRFB and surgeon's preference. In one method, the IRFB was lifted from the retinal surface with an intraocular magnet and brought to the anterior vitreous. Subsequently, the sclerotomy site used for illumination was adequately enlarged. Care was taken to expand the uveal tissue as much as the sclera. The light pipe was replaced by suitable forceps according to the size and shape of the foreign body. The foreign body was grasped with intraocular forceps under coaxial illumination from the surgical microscope. Careful attention was given to avoid damage to the lens in phakic eyes. In the other method, an external electromagnet was used initially. The sclerotomy closest to the IRFB was enlarged. Next, the tip of the electromagnet was placed at the sclerotomy incision and the foreign body was extracted from the eye.

Nonmagnetic IRFBs were lifted from the retinal surface using an extrusion needle or by suction of the vitrectomy probe and then removed using intraocular forceps. Immediately after extraction of the IRFB, vitrectomy was repeated to remove any residual membranes or dispersed particles of the IRFB and its capsule. Thereafter, an indirect ophthalmoscopic examination was performed with scleral depression and iatrogenic retinal breaks were treated using endolaser photocoagulation or trans-scleral cryotherapy.

### Statistical Analysis

All data were analyzed using SPSS software version 15.0 (SPSS Inc., Chicago, Illinois, USA) employing the Chi-square test. Significance level was set at 0.05.

**RESULTS**

Of 449 patients referred to our centers for ocular trauma associated with IOFBs, 34 eyes of 33 patients had IRFBs. All patients were male with mean age of 28±12.3 (range 8 to 54) years. Mean follow-up period was 24.5±2.3 (range 10 to 89) months. The left eye was involved in 17 (50%) cases and the right eye was traumatized in 15 (44.2%) patients. Both eyes were involved in another subject (5.8%). Relative afferent pupillary defect was noted in 12 (35.7%) eyes at presentation. Of a total of 33 incidents, 24 (72.7%) injuries were work-related and 9 (27.3%) were war-related.

The site of penetration was the cornea and the sclera, each in 15 (44.1%) eyes and the limbus in 4 (11.76%) eyes. Corneal or scleral lacerations were repaired in 14 eyes (41.2%) and were self-sealed in the remaining.

Vitreous hemorrhage (mild to severe) was present in 19 eyes (55.9%). The IRFB was single in all eyes ranging in size from 0.5x0.5x0.5 mm to 6x7x3 mm and was ferromagnetic in 29 (83.3%) eyes. Characteristics of the IRFBs are shown in Table 1. The long axis of the IRFB was shorter than 1.5 mm in 10 (29.4%) cases and the foreign body was located anterior to the equator in 26 (76.5%) eyes.

**Table 1.** Frequency of IRFBs based on their characteristics among 34 studied eyes

IRFB characteristic	Frequency	Percentage (%)
Size, mm		
<1.5	10	29.4
1.5-3	10	29.4
>3	6	17.6
Unknown	8	23.6
Type		
Metal	29	85.3
Stone	3	8.9
Glass	1	2.9
Unknown	1	2.9
Location		
Anterior to equator	27	79.4
Posterior to equator	7	20.6
Time interval between injury and surgery		
< 2 weeks	14	41.2
2 – 4 weeks	10	29.4
1 – 6 months	5	14.7
> 6 months	6	17.7

IRFB, intraretinal foreign body

Of 34 eyes, 15 (44.1%) had lens opacities and underwent cataract surgery during IRFB removal. In 9 eyes (26.5%) a posterior chamber intraocular lens (PCIOL) was implanted in the same session. In two eyes, lens opacity progressed after surgery and cataract extraction with PCIOL implantation was performed after six months.

Argon laser photocoagulation was performed around the embedded foreign body before surgery in 7 (20.6%) eyes; this procedure was not feasible due to significant media opacity in other eyes. Retinal detachment complicated by proliferative vitreoretinopathy (PVR) was present in two eyes preoperatively. After performing vitrectomy, membrane peeling, and IRFB extraction in these two eyes, 1000 cs silicone oil was injected for internal tamponade. Retinal breaks were observed intraoperatively in 15 (44.1%) eyes. The location of the retinal breaks was posterior to the sclerotomy in 12 (35.3%) cases. Sclerotomy-related retinal breaks were treated with endolaser photocoagulation (8 eyes) or cryotherapy (4 eyes) in addition to internal tamponade with SF6. In 3 eyes (8.8%) without previous history of endolaser photocoagulation, retinal breaks developed at the site of the embedded foreign bodies during the operation. These breaks were treated with endolaser photocoagulation and internal tamponade using SF6.

The time interval between injury and IRFB removal was less than 2 weeks in 13 (38.2%) eyes and less than 4 weeks in 23 (67.6%) eyes. Multivariate analysis showed that final visual acuity of 20/200 or better was independent of the interval to surgery (P=0.46). The method of IRFB extraction varied according to the type and size of the foreign body, and the experience of the surgeon. Extraction of the IRFB was performed through the sclerotomy site using an external magnet in 12 (35.3%) eyes or employing forceps in 20 (58.8%) eyes; the foreign body was removed through the limbus in 2 (5.9%) cases.

Final visual acuity was 20/40 or better in 12 (35.3%) eyes and 20/200 or better in 23 (67.7%) eyes (Fig. 1). Visual acuity showed an improvement in 24 (70.6%) eyes, remained unchanged in 2 (5.9%) eyes and deteriorated in 8 (23.5%) eyes

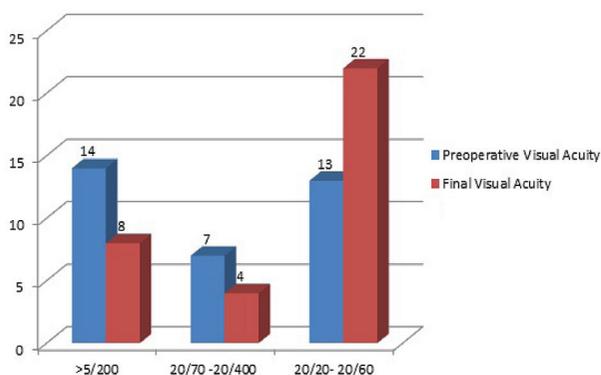


Figure 1. Pre- and postoperative visual acuity.

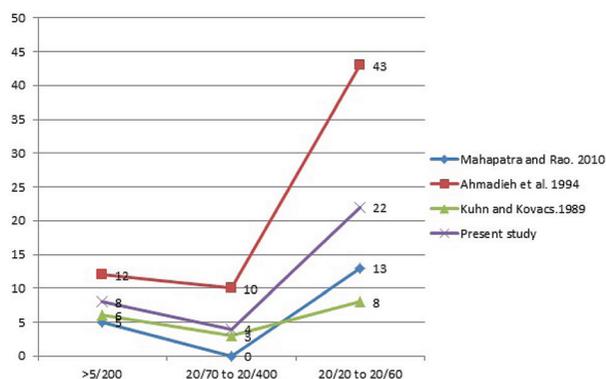


Figure 2. Final visual acuity of our patients compared to other studies.

postoperatively. Postoperative improvement of visual acuity was statistically significant (P=0.006). Final visual acuity of 20/200 or better had no significant association with the technique of IRFB extraction (P=0.6), or its size (P=0.3) or type (P=0.37). Final visual acuity of our study was compared to the previous reports (Fig. 2).

## DISCUSSION

Herein we present the visual outcomes and complications of surgical management for IRFBs

in 33 patients with penetrating intraocular injury who underwent vitrectomy and foreign body removal. The number and type of foreign bodies, final visual acuity, and important observations reported in the literature were compared to the present study (Table 2). The retina was attached at final examination in all eyes and visual acuity was improved in approximately 70% of eyes. No improvement or some deterioration of visual acuity was observed in a few cases which might have been due to different causes such as chronic cystoid macular edema, macular scar, delay in

Table 2. The number and type of foreign bodies, final visual acuity, and important observations reported in the available literature compared to the present study

Reference	No. of eyes	IRFB/IOFB type	FVA		Important observation
			Value	Percentage (%)	
Slusher et al. <sup>5</sup> 1982	14	Metallic	≥20/400	40	A tendency for macular pucker and RD with massive periretinal proliferation
Kuhn and Kovacs <sup>6</sup> 1989	17	Magnetic	≥20/400	64.7	Total or partial retinal attachment was achieved in 71% of cases
Ahmadiéh et al. <sup>7</sup> 1994	75	Metallic	≥20/200	47	Complete retinal attachment was present in 75% of eyes
Chiquet et al. <sup>21</sup> 2002	102	Metallic and magnetic			Two independent and combined factors were predictive of RD: worse initial VA and presence of vitreous hemorrhage
Wani et al. <sup>22</sup> 2003	40	-----	≥20/40	47.5	Poor visual outcome was associated with initial poor VA and postoperative RD Good visual outcome was associated with the absence of lens injury and absence of postoperative RD
Wickham et al. <sup>23</sup> 2006	140	Metal	≥6/36	53	Postoperative RD and PVR were predictive of poor final VA
Mahapatra and Rao <sup>13</sup> 2010	18	-----	≥20/30	61.2	Five cases developed RD and PVR
Present study 2013	34	Ferromagnetic	≥20/40 ≥20/200	35.2 67.6	There was no significant relationship between a final VA of 20/200 or better and site, size, and type of IRFB or time of surgical intervention

IRFB, intraretinal foreign body; IOFB, intraocular foreign bodies; FVA, final visual acuity; RD, retinal detachment; VA, visual acuity; PVR, proliferative vitreoretinopathy

IRFB removal, or surgical trauma.

At the time of surgical repair, some eyes had self-sealing wounds in our series. Therefore it may be possible to perform primary repair together with vitrectomy and IOFB removal in a single session.

Lack of a significant relationship between siderosis bulbi and final visual acuity in our study could be due to the peripheral location of the IRFBs with no macular involvement. In a previous report from our center<sup>7</sup> over a 10-year period, war-related trauma was the main cause of IOFBs; however work-related injuries were the predominant cause of IRFBs in the current series.

In cases with penetration of the foreign body through the cornea and traumatic lens opacity, we performed cataract extraction and PCIOL implantation. Other studies similarly reported encouraging outcomes following PCIOL implantation combined with cataract extraction and IOFB removal.<sup>8-11</sup>

Before the availability of vitrectomy, IRFB extraction was associated with a high rate of complications. Percival et al<sup>9</sup> reported retinal detachment in 84.6% of eyes with IRFBs for which extraction was performed through a posterior route. The best method for removing magnetic foreign bodies lodged in the posterior segment remains controversial; some surgeons prefer to use intraocular forceps,<sup>12,13</sup> while others believe that magnetic extraction allows better control, minimizes surgical trauma and reduces postoperative inflammation.<sup>14-16</sup>

The outcomes of vitreous surgery and extraction of magnetic and non-magnetic foreign bodies in our study seem favorable. In the report by Slusher et al,<sup>8</sup> final visual acuity of 20/200 or better was achieved in 44% of cases. These authors reported macular pucker in more than 60% of their patients in one study<sup>8</sup> and in 90% of cases in another.<sup>17</sup> Macular pucker occurred in 10% of eyes in the current series and in 10.5% of eyes in our previous report.<sup>7</sup> The risk of macular pucker is especially high when the foreign body is embedded along or within the temporal vascular arcades.<sup>8</sup> The low rate of macular pucker in this study may be due to the location of the IRFBs which were mainly

anterior to the equator, outside the vascular arcades. Careful removal of the posterior hyaloid face also plays an important role in reducing the risk of postoperative macular pucker.

We performed barrier laser photocoagulation around the embedded foreign body before removal when media clarity was adequate.

Iatrogenic peripheral retinal breaks continue to be an important complication of pars plana vitrectomy with a reported incidence of 6 to 11% which is highly dependent on the underlying disorder. The highest incidence has been reported with surgical management of proliferative diabetic retinopathy (22%) and the lowest frequency has been reported with extraction of epiretinal foreign bodies.<sup>3</sup> Iatrogenic peripheral breaks usually occur along the posterior margin of the vitreous base and are located posterior to the sclerotomy sites.<sup>7</sup> The proposed mechanism for development of these breaks is instrument insertion, which may cause traction on the adjacent vitreous leading to a retinal tear along the posterior border of the vitreous base. Alternatively, vitreous may become incarcerated in the sclerotomy site upon withdrawal of an instrument, causing traction and retinal breaks along the posterior border of the vitreous base. Peripheral retinal breaks are correlated with multiple passage and exchange of instruments through the sclerotomy. Early detection of iatrogenic peripheral breaks and proper treatment are critical in preventing subsequent retinal detachment and PVR. In the current series,<sup>14</sup> the rate of iatrogenic retinal break formation posterior to the sclerotomy site was fairly high. Placement of an encircling prophylactic silicone band can reduce the risk of delayed retinal detachment in eyes with penetrating ocular trauma treated with vitrectomy.<sup>3,8,18</sup> We used a prophylactic band in all cases; performing meticulous vitrectomy, particularly removal of condensed vitreous along the entrance and impact sites, and removal of the posterior hyaloid is also effective in reducing the risk of tractional retinal detachment.<sup>7,8</sup>

Immediate vitrectomy and IOFB removal within the same session of primary repair may be considered in the presence of endophthalmitis or in cases which the foreign body is composed of

pure copper or other highly reactive materials.<sup>7</sup> None of the eyes in our series had developed endophthalmitis.

In the presence of severe vitreous hemorrhage, it has been recommended to perform vitrectomy and IRFB removal within 5 days of injury.<sup>7</sup> In our series, about half of the cases had moderate to severe vitreous hemorrhage, which was not significantly related to the final visual outcome. It has been reported that timing of vitrectomy and foreign body removal was correlated with final visual outcomes.<sup>19,20</sup> Overall, in cases of mild to moderate vitreous hemorrhage and an attached retina, it is recommended to perform retinopexy around the embedded foreign body within two weeks before vitrectomy and IRFB removal.<sup>7,19,20</sup>

The more deeply embedded an IRFB, the more complicated its removal.<sup>8</sup> A deeply embedded foreign body associated with choroidal hemorrhage can lead to subretinal fibrosis. In such cases, a retinotomy may be necessary to mobilize the IRFB. If these changes occur within the vascular arcades, they can lead to severe and irreversible loss of visual acuity.<sup>3,8</sup>

In our study, 3 eyes had rhegmatogenous retinal detachment at the site of foreign body impact after removal and two eyes had choroidal hemorrhage which improved without intervention in one case. In the other case, subretinal fibrosis occurred and because of its proximity to the macular region, resulted in severe visual loss. Slusher et al<sup>5</sup> reported such changes in 90% of their cases. Rhegmatogenous retinal detachment after penetrating trauma is rapidly and severely complicated by PVR.<sup>24</sup> In the study by Ahmadieh et al,<sup>7</sup> PVR was mentioned as the main reason for failure of retinal reattachment surgery in eyes with rhegmatogenous retinal detachment while in our series, only 3 (9%) cases demonstrated rhegmatogenous retinal detachment pre- or postoperatively. Complete retinal reattachment was achieved in all of our cases at final follow-up. In the study by Ahmadieh et al<sup>7</sup> total or partial retinal detachment involving the macula was present in 9 of 25 eyes (36%) at final examination. This rate was 29% in the study by Kuhn et al.<sup>6</sup>

In summary, the anatomical and functional results of IRFB extraction were satisfactory in our series, but independent of IRFB size and type. Performing a meticulous vitreoretinal procedure is mandatory to minimize the rate of iatrogenic peripheral retinal breaks. No significant difference was observed between external magnets and intraocular forceps for extraction of IRFBs, therefore either method can be employed based on surgeon's experience and skill, and also the size and type of the foreign body.

### Conflicts of Interest

None.

### REFERENCES

- Shock J, Adams D. Long-term visual acuity results after penetrating and perforating ocular injuries. *Am J Ophthalmol* 1985;100:714-718.
- Thompson JT, Parver LM, Enger CL, Mieler WF, Liggett PE. Infectious endophthalmitis after penetrating injuries with retained intraocular foreign bodies. National Eye Trauma System. *Ophthalmology* 1993;100:1468-1474.
- Ahmadieh H, Soheilian M, Sajjadi H, Azarmina M, Abrishami M. Vitrectomy in ocular trauma. Factors influencing final visual outcome. *Retina* 1993;13:107-113.
- Kuhn F, Mester V, Morris R. Intraocular foreign bodies. In: Kuhn F, Pieramici D (eds). *Ocular Trauma: Principles and Practice*. USA: Thieme Medical Publishers; 2002: 235-263.
- Slusher MM, Sarin LK, Federman JL. Management of intraretinal foreign bodies. *Ophthalmology* 1982;89:369-373.
- Kuhn F, Kovacs B. Management of postequatorial magnetic intraretinal foreign bodies. *Int Ophthalmol* 1989;13:321-325.
- Ahmadieh H, Sajjadi H, Azarmina M, Soheilian M, Baharivand N. Surgical management of intraretinal foreign bodies. *Retina* 1994;14:397-403.
- Slusher MM. Intraretinal foreign bodies. Management and observations. *Retina* 1990;10:S50-54.
- Percival SP. Late complications from posterior segment intraocular foreign bodies with particular reference to retinal detachment. *Br J Ophthalmol* 1972;56:462-468.

10. Slusher MM, Greven CM, Yu DD. Posterior chamber intraocular lens implantation combined with lensectomy-vitreotomy and intraretinal foreign-body removal. *Arch Ophthalmol* 1992;110:127-129.
11. Koenig SB, Mieler WF, Han DP, Abrams GW. Combined phacoemulsification, pars plana vitrectomy, and posterior chamber intraocular lens insertion. *Arch Ophthalmol* 1992;110:1101-1104.
12. Soheilian M, Ahmadieh H, Afghan MH, Sajjadi SH, Azarmina M, Peyman GA. Posterior segment triple surgery after traumatic eye injuries. *Ophthalmic Surg* 1995;26:338-342.
13. Mahapatra S.K, Rao NG. Visual outcome of pars plana vitrectomy with intraocular foreign body removal through sclerocorneal tunnel and sulcus-fixed intraocular lens implantation as a single procedure, in cases of metallic intraocular foreign body with traumatic cataract. *Ind J Ophthalmol* 2010;58:115-118.
14. Cox M, Hassan T. Management of posterior segment trauma. *Duane's Ophthalmology on CD-ROM*. Philadelphia, Pa: Lippincott-Raven Publishers; 1996.
15. Coleman DJ, Lucas BC, Rondeau MJ, Chang S. Management of intraocular foreign bodies. *Ophthalmology* 1987;94:1647-1653.
16. Arciniegas A, Araya R. Our experience in intraocular foreign-body removal. *Ann Ophthalmol* 1992;24:453-458.
17. McCabe C, Mieler W, Postel E. Surgical management of intraocular foreign bodies. *Vitreoretinal Surgery of the Injured Eye*. Philadelphia, PA: Lippincott-Raven; 1999.
18. De Souza S, Howcroft MJ. Management of posterior segment intraocular foreign bodies: 14 years' experience. *Can J Ophthalmol* 1999;34:23-29.
19. Brinton GS, Aaberg TM, Reeser FH, Topping TM, Abrams GW. Surgical results in ocular trauma involving the posterior segment. *Am J Ophthalmol* 1982;93:271-278.
20. De Juan E Jr, Sternberg P Jr, Michels RG. Penetrating ocular injuries. Types of injuries and visual results. *Ophthalmology* 1983;90:1318-1322.
21. Chiquet C, Gain P, Zech JC, Adeleine P, Denis P. Risk factors for secondary retinal detachment after extraction of intraocular foreign bodies. *Can J Ophthalmol* 2002;37:168-176.
22. Wani VB, Al-Ajmi M, Thalib L, Azad RV, Abul M, Al-Ghanim M, et al. Vitrectomy for posterior segment intraocular foreign bodies: visual results and prognostic factors. *Retina* 2003;23:654-660.
23. Wickham L, Xing W, Bunce C, Sullivan P. Outcomes of surgery for posterior segment intraocular foreign bodies-a retrospective review of 17 years of clinical experience. *Graefe's Arch Clin Exp Ophthalmol* 2006;244:1620-1626.
24. Claes C, Freeman HM, Tolentino FL. Proliferative vitreoretinopathy: An overview. In: Freeman HM, Tolentino FL (eds). *Proliferative Vitreoretinopathy (PVR)*. New York: Springer-Verlag; 1988: 3-11.