A Comparative Study of Temporalis Fascia Graft and Vein Graft in Myringoplasty

Pradipta Kumar Parida · Santhosh Kumar Nochikattil ·
Gopalakrishnan Surianarayanan · Sunil Kumar Saxena ·
Sivaraman Ganesan

Received: 7 December 2011 / Accepted: 8 March 2012 / Published online: 17 March 2012
© Association of Otolaryngologists of India 2012

Abstract To compare the surgical outcome of temporalis fascia graft (TFG) and vein graft (VG) in myringoplasty. This prospective study was carried out over 60 patients with inactive tubotympanic type of chronic suppurative otitis media, with small to moderate size central perforation in Jawaharlal Institute of Post Graduate Medical Education and Research, Puducherry from November 2009 to March 2011. Patients were equally randomized into two groups; TFG group and VG group according to the graft material used for myringoplasty. After routine investigations, X-ray mastoid and paranasal sinuses and pure tone audiometry, all cases were operated under local anesthesia using underlay technique. Patients were followed at 2 week, 1 and 3 month postoperatively. Graft uptake, audiological improvement, degree of hearing improvement, and complications were studied during follow up. In TFG group, graft uptake rate was 80 % and hearing improvement was present in 66.7 % whereas in VG group graft uptake rate was 83.3 % and hearing improvement was present in 70 %. No patient had deterioration in hearing, sensory neural hearing loss or any other complications postoperatively. Difference between the preoperative and postoperative air bone (AB) gap was considered as degree of hearing improvement. Postoperative AB gap was <10 dB in 60 % and 66.7 % of patients of TFG group and VG group respectively. The difference in graft uptake rate and hearing improvement between two groups was not statistically significant. Both TFG and VG are equally effective in terms of graft uptake and hearing improvement in myringoplasty.

Keywords Myringoplasty · Temporalis fascia graft · Vein graft · Otitis media · Hearing · Graft take up

Introduction

Myringoplasty is the surgical procedure to repair tympanic membrane perforations and thereby improving hearing, providing a dry ear and reducing susceptibility to infections [1]. Myringoplasty is accomplished by underlay or overlay technique depending on whether the graft is placed medial or lateral to tympanic membrane remnant [1, 2]. Success in myringoplasty is usually assessed in terms of healing of the perforation as well as hearing gain [1, 3]. The modern era of middle ear surgery began with the introduction of tympanoplasty by Zollner and Wullstein [4, 5]. The use of vein grafts for myringoplasty was first described by Shea [6]. Heerman was the first to use temporalis fascia for myringoplasty [1]. Since then myringoplasty surgery came a long way adopting various techniques and innumerable graft materials to close the tympanic membrane perforations. Autologous temporalis fascia is the most commonly used grafting material because of its convenient location and resistant to infection. Many other materials like skin, homologous tympanic membrane, dura, tragal cartilage, perichondrium and vein had been used with varying results. There are various studies reporting various results using temporalis fascia and vein. But, there are very few studies, which compared the efficacy of myringoplasties with vein and temporalis fascia.

Though, there are many different kinds of techniques and graft materials used, a survey of literature does not establish indisputably that a particular method is superior to the other. In the literature success rate of myringoplasties with temporalis fascia, vein graft, cartilage and

P. K. Parida (✉) · S. K. Nochikattil · G. Surianarayanan ·
S. K. Saxena · S. Ganesan
Department of E.N.T., Jawaharlal Institute of Post Graduate
Medical Education and Research, Puducherry 605006, India
e-mail: drpradipta04@gmail.com

perichondrium touches 80–90 %. There are conflicting reports, which claim superiority of one procedure over the other. The purpose of this study was to assess and compare the surgical outcome of temporalis fascia graft (TFG) and vein graft (VG) in myringoplasty, in terms of graft uptake, audiological improvement, degree of hearing improvement and complications. Possible causes for failure of myringoplasties were also analyzed and discussed.

Materials and Methods

The present study was conducted over 60 patients of inactive tubotympanic type of chronic suppurative otitis media (CSOM) with small to moderate size central perforations from November 2009 to March 2011. All patients were of 18–50 years of age and had adequate cochlear reserve. Patients with large perforation of tympanic membrane, actively discharging ear, sensory neural or mixed hearing loss, attico-antral type of CSOM, those with residual disease or recurrent perforation and tympanosclerosis were excluded from the study. The study was reviewed and approved by the Ethical committee of our institution.

The cases were randomly divided into 2 groups of 30 each by block randomization; TFG group and VG group according to graft used for myringoplasty. All the cases were subjected to routine investigations, X-ray of mastoids (Law's view), X-ray paranasal sinuses and pure tone audiogram (PTA) to assess preoperative hearing loss. All cases were operated by transcanal route under local anesthesia using underlay technique. During surgery the ossicular mobility was tested by round window reflex method and the reflex was seen in all the cases indicating ossicular chain integrity. The VG was harvested from the dorsum of the left hand as described Tabb [7]. The VG was placed in such a way that the endothelial surface faced medially. All patients received amoxicillin for 5 days. The patients were followed up at 2 week, 1, and 3 months after surgery. Graft uptake, audiological improvement, degree of hearing improvement, and complications were studied during follow up visits. Graft take up was assessed by otoscopy and microscopic examination and hearing improvement was assessed by postoperative PTA 1, and 3 months after surgery.

Results

In this study, 61.7 % patients belonged to the age group of 18–27 years. The mean age of vein graft group and the temporalis fascia group was 28.33 and 27.57 respectively. Out of 60 patients, 45 were females and 15 were male. Ear discharge and hearing loss was the most common

presenting symptom (Table 1). Most of the patients had unilateral small or moderate size central perforation (Table 1). Type of mastoid on X-ray and preoperative air bone gap (AB gap) are shown in Table 1. Sequential status of graft (graft take up rate) in post operative follow ups is shown in Table 2. Graft failure was present in 11 (18.3 %) [6 (20 %) in TFG group and 5 (16.7 %) in VF group] out of 60 patients at 3 months follow up. Hearing improvement in the study groups is shown in Table 3. The air-bone (AB) gap at the 3rd postoperative month is taken as maximum level of achievement of AB gap closure (final outcome).

Table 1 Showing presenting symptoms, ear affected, findings of X-ray mastoid and preoperative air-bone (AB) gap

	Vein graft group		Temporalis fascia graft group	
	n = 30	%	n = 30	%
Presenting symptoms				
Ear discharge	15	50	14	46.67
Hearing loss	10	33.3	9	30
Ear ache	4	13.3	5	16.67
Ear affected (tympanic membrane perforation)				
Right	15	50	16	53.3
Left	11	36.7	9	30
Bilateral	4	13.3	5	16.67
Type of mastoid on X-ray of operated ear				
Sclerotic	20	66.7	19	63.33
Diploic	7	23.3	8	26.67
Cellular	3	10	3	10
Pre-operative AB Gap (dB)				
Mean	22.75		21.63	
Minimum	10		8	
Maximum	42		40	
Range of pre-operative AB Gap (dB)				
<25	18	60	19	63.3
25–40	10	33.3	10	33.3
>40	2	6.67	1	3.3

Table 2 Status of the graft (graft take up rate) in postoperative follow ups

Follow up period	Vein graft group				Temporalis fascia graft group			
	Intact		Failure		Intact		Failure	
	n	%	n	%	N	%	n	%
14th day	30	100	0	0	30	100	0	0
1st month	30	100	0	0	30	100	0	0
3rd month	25	83.3	5	16.7	24	80	6	20

Table 3 Post-operative hearing improvement in the study groups

Follow up visit	Vein graft group				Temporalis fascia graft group			
	Present		Absent		Present		Absent	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
1st month	21	70	9	30	20	66.7	10	33.3
3rd month	21	70	9	30	20	66.7	10	33.3

Table 4 Mean air-bone (AB) gap at various intervals

Study groups	Preoperative AB gap (dB) (1)	Post-operative AB gap at 1st month (dB)	Post-operative AB gap at 3rd month (dB) (2)	Post-operative closure of AB gap 1–2 (dB)
Vein graft group	22.75	11.7	6.5	16.25
Temporalis fascia graft group	21.63	10.5	5.7	15.93

Measurement of AB gap closure was taken as a guide to study the degree of hearing improvement (Table 4). The postoperative AB gap was categorized into 2 groups; ≥ 10 and ≤ 10 dB (Table 5). There was no significant difference in graft uptake, hearing improvements and degree of improvement between the two groups.

Graft site wound infection rate was slightly higher in VG group in comparison to TFG group (13.3 vs. 3.3 %). There were no major complications in two groups. There was no nausea, vomiting and bleeding postoperatively in both the groups.

Discussion

CSOM is a major cause of acquired and preventable hearing loss, particularly in the developing world. Myringoplasty restores/improves patient's hearing and decrease the susceptibility to infection [8]. Temporalis fascia, vein and tragal perichondrium are commonly used graft material. Myringoplasty can be performed using either overlay technique or underlay technique [1, 3]. The underlay method can be achieved by either trans-canal approach or post-aural approach.

Pediatric age group was kept out of this study because this age group is still considered to have high failure rate because of possibilities of eustachian tube dysfunction, middle ear effusion and patient management problems [9–11]. Elderly population was excluded from the study because of many associated medical problems like diabetes mellitus, hypertension, presbycusis and sensory neural hearing loss.

Patients with small or moderate central perforations were included in the present study because of the fact that limited size of the autologous VG, which would be insufficient to close larger perforation [6, 12]. Shea who first

Table 5 Post-operative air-bone (AB) gap

Postoperative AB gap	<10 dB		>10 dB	
	Number of patients	% age	Number of patients	% age
Vein graft group (<i>n</i> = 21)	14	66.7	7	33.3
Temporalis fascia graft (<i>n</i> = 20)	12	60	8	40

used VG advised not to use VG if the defect in the tympanic membrane is occupying more than 40 % of the tympanic membrane area [6]. It is difficult or impossible to bridge a large perforation by VG [12, 13]. The failure rate was high while repairing large tympanic membrane perforations, using VG [12, 13]. It is obvious from the various studies that VG are suited for small or moderate size perforations [12, 13]. High failure rate (6.5–20 %) has been reported with larger perforation irrespective of grafting material used [12, 14]. But according to study of Wasson et al. [15] neither perforation size nor any other assessed variable was a statistically significant determinant factor for successful myringoplasty. Inactive ears were preferred for the study to rule out the focus of infection and resultant graft failure. However, Adkins and white [14] found in his study that preoperative dry intervals do not influence the outcome of the surgery. In our study, 65 % of patients had sclerotic mastoid. The influence of sclerosis of mastoid over the outcome of surgery was not significant in both the groups. This is consistent with the study of Jacker and Schindler. [16].

Technique of Myringoplasty

The technique employed in our study was underlay technique. Since overlay technique is associated with various complications like blunting of anterior meatal angle, lateral migration of the graft, epithelial pearls and graft cholesteatoma, underlay technique is routinely followed in our hospital. Regarding hearing results, both the methods carry equally good results [9, 10, 17].

Regarding harvesting the graft, it was easier in the case of TFG. Temporalis fascia was easily accessible as it is close to the operation site. It was relatively easy to prepare, handle and placing the TFG. In our experience harvesting

the VG was technically difficult and more time consuming than harvesting temporalis fascia. After removing excess of connective tissue over the adventitia, the prepared VG was extremely thin, compared to temporalis fascia; hence difficult to handle. Placing the VG through the tympanomeatal flap was also difficult as the graft has the tendency to roll up. There is difference of opinion regarding placing the VG that, whether the intima should face medially or laterally [7]. Shea [6] and Tabb [7] have reported the use of VG with endothelium inwards because endothelium facing inwards minimizes adhesions and the rough sticky adventitia adhering well to the prepared inner drum margin. Nickel [18] employed the VG by placing the intima either inwards or outwards without any obvious difference.

Graft Success

In our study the overall success rate of myringoplasty was 81.6 %. The success rate with TFG was 80 % while that with VG was 83.3 %. This was below the overall success rate reported by different authors especially for temporalis fascia. The difference in success rates between the graft materials was not statistically significant. Some of the important studies using TFG showed success rate of 80–99 % [9, 10, 19, 20]. Similarly in the studies employing VG the results were 50–92 % [6, 7, 13, 19, 21]. In our study, the patients who had residual partial tympanic membrane perforations at third month of postoperative follow up were considered as failures. In a study by Strahan et al. [19] highlighted the fact that in the long run (>1.6 year) VG myringoplasty would be unsuccessful with high rate of reperforation. The authors suggested that, though the studies by Tabb [7] and Shea [6] reported high success rate with VG myringoplasty, their follow up period was consistently short. According to Palva and Virtanen [22] for successful myringoplasty prerequisites are faultless surgical technique and strict adherence to it at all phases of surgery. In a study by Vartiainen, out of the 38 failed myringoplasty cases, 24 occurred in immediate post-operative period amounting to 63 % of the failures [23].

Many studies suggested that infection was not a factor in early failures but it was associated with late graft failure in 10.5–13 % cases [14, 23]. In the present study, postoperative infection and discharge was found in 6 cases (10 %). All of these 6 cases had residual perforation at the end of third month of postoperative follow up.

MacKinnon [24] in their study concluded that recurrent suppurative otitis media leading to failure of myringoplasty was neither dependent on poor eustachian tube function, nor on a long time discharge free interval before myringoplasty. In some cases where discharge was associated with intact graft otoscopically, it may be attributed to

minute defect in the healed membrane, which escaped clinical detection [24].

In some cases of graft failure cause may be attributed to avascular necrosis of the graft due to a progressive deterioration of blood supply from the periphery of the tympanic membrane [24]. In many series, 32–40 % of the graft failures were attributed to this kind of atrophy of the graft [23, 24]. Vartiainen's study attributes atrophy of the graft as the commonest cause of late failure [23].

Many otologists prefer to do cortical mastoidectomy with myringoplasty in discharging ear with sclerotic mastoid on X-ray. Balyan et al. [25] operated discharging ear with sclerotic mastoid and showed that there was no statistically significant differences between the outcome of myringoplasty in patients who had undergone simple mastoidectomy plus myringoplasty and those without mastoidectomy. But in the study of Puhakka et al. [8] the results were significantly poor if preoperative X-Ray mastoid was sclerotic. Mastoid size does not have any effect on healing of tympanic membrane perforation [16]. It has been found that all the small sized mastoids were associated with inflammatory disease of the mucosa and in no case with a medium or large size mastoid system showed signs of inflammation at operation [16]. There was no statistically significant difference between the inflamed and non-inflamed types of mastoid on healing of tympanic membrane perforation [16]. In our series, all 6 postoperative ear discharge cases had sclerotic mastoid. Thus it can be pointed out that lurking infection in the mastoid antrum could be responsible for recurrent suppurative otitis media seen post-operatively.

In the present study bilateral disease influenced the success of the graft uptake. Bilateral disease was present in 2 cases (40 %) of vein graft failures and 3 cases (50 %) of temporalis fascia failures. Similar findings are shown in few studies which pointed out that bilateral disease is associated with poor outcome compared to unilateral disease^{96, 97}. In a study by Adkins and White [14] 25 % adult myringoplasty failures and 75 % of failures in children were observed in cases with bilaterally discharging ears. But according to the study by Packer et al. [17] where overall result of myringoplasty success was close to 90 %, the success rate with bilateral chronic otitis media cases was 87 %; the difference was not statically significant.

Hearing Improvement

Measurement of AB gap closure was taken as a guide to study the hearing improvement. Analysis of hearing improvement was done for cases with successful graft uptake. Seventy percent of the patients in VG group had hearing improvement compared to 66.7 % in TFG group.

The difference in hearing improvement between the two groups was not statistically significant.

In our study AB gap considered closed if it was less than or equal to 10 dB [19, 26]. In our study, 26 (14 belonged to VG myringoplasty group and 12 were in the temporalis fascia myringoplasty group) out of the total 41 patients with successful graft uptake had the AB gap closed to less than 10 dB post operatively at the end of third month. Difference between the VG myringoplasty group and temporalis fascia myringoplasty group regarding closure of AB gap was not statistically significant. Booth [26] in his study regarding hearing improvement after myringoplasty considered AB gap as closed if it was not greater than 15 dB.

AB gap closure alone could not be taken as an indicator of improvement audiometrically because closing of AB gap might still leave the patient with a postoperative hearing loss where bone conduction may be worse than preoperative level [26]. In our series, all the patients who had successful graft uptake had normal bone conduction level and subjective hearing improvement. In our study, closure of AB gap was significant when pre- and post-operative AB gap comparison was made for each group.

Hordijk and Rietema [21] considered a postoperative conductive hearing loss of 30 dB or more, or an auditory gain of 15 dB or less as an unsatisfactory hearing result [21]. In our study the mean auditory gain was more than 15 dB in comparison to mean preoperative hearing loss 22.19 dB. Results with VG regarding post-operative hearing improvement are comparable to that of TFG [21]. Tabb [7] has reported 100 % successful graft take up and hearing improvement using autologous VG taken from dorsum of hand. According to Wasson et al. [15], the collective myringoplasty success rate was 80.8 percent and for successful patients, the mean air conduction audiometric gain was 6.8 dB. Myringoplasty using TFG and underlay technique had hearing improvement in 70–80 % of patients at the end of 1 year follow up [9, 17]. In a study by Packer et al. [17] reported average AB gap closure was 11.8 dB. In our study average AB gap closure was 16.09 dB.

In Strahan et al. [19] study, hearing restoration was judged successful if the averages postoperative bone air gap was less than 10 dB or if the air conduction was 30 dB or less. According to this study, in the case of underlay technique hearing restoration was gained in 91 % of VG cases and 82 % in temporalis fascia cases. The difference was not significant. But using overlay method 82 % of patients in VG myringoplasty group had hearing improvement while it was only 67 % in cases using TFG⁸².

In our present study 66.7 % in VG myringoplasty group and 70 % in TFG group had hearing improvement. This is against the theoretical concept that a successful myringoplasty will lead to perfect hearing result. The most likely

explanation for this is that in most cases of chronic otitis media, even though the ossicular chain may appear normal, there is some factor of scar tissue which prevents total restoration of hearing [9]. The present study's hearing results are comparable to other series [9, 10].

Complications

Myringoplasty is generally regarded as a safe procedure. Complications associated with myringoplasty are graft failure, infections, sensory neural hearing loss, ossicular discontinuity, fascial nerve palsy, chorda tympani damage, external auditory canal stenosis, serous otitis media, perichondritis, retraction of tympanic membrane and tinnitus. Toss et al. [27] reported 1.3 % incidence of high tone hearing loss following myringoplasties. Siraj and Mohammad [28] found 2 % incidence of sensory neural hearing loss with temporalis fascia graft and 9 % incidence with dura graft. In the study of Sade et al. [29], the incidence of retracted tympanic membrane in successful myringoplasties using TFG was 11 %. Paker et al. [17] observed one case of debilitating tinnitus post operatively which was associated with sensorineural hearing loss. Glasscock et al. [10] reported 1 % incidence of EAC stenosis in his study.

Among the above mentioned complications only graft failure was noted in our study. Graft failure was present in 11 (18.3 %) out of 60 patients. Out of which five (16.7 %) patients were from VG group and six (20 %) patients were TFG group. In our study graft site wound infection was noted in 4 (13.3 %) patients in VG group as compared to one (3.3 %) patient in TFG group. However the difference was statistically not significant.

Summary and Conclusions

The graft uptake rate was 83.3 and 80 % of the patients for VG myringoplasty and TFG myringoplasty respectively at the end of third month of follow up. The degree of hearing improvement was calculated by finding the difference between pre- and post-operative AB gap. Hearing improvement was noticed in 70 % of the patients of VG group and 66.7 % of the patients of TFG group. The difference in graft take up, hearing improvement and the degree of hearing improvement between the two groups was not statistically significant.

Thus in the present study, both VG and TFG have proved to be equally efficacious in terms of graft take up and hearing improvement when used in myringoplasty for small or moderate size tympanic membrane perforation. The type of mastoid on X-ray and the laterally (unilateral/bilateral) of ear discharge were not significantly

influencing the surgical outcome. There were technical difficulties in handling the VG and there was slightly higher rate of graft site wound infection VG group.

Conflict of interest None.

References

1. Athanasiadis-Simanis A (2010) Tympanoplasty: tympanic membrane repair. In: Gulya AJ, Minor LB, Poe DS (eds) Glasscock-shambaugh surgery of the ear, 6th edn. Peoples Medical Publishing House, Shelton, pp 468–478
2. Glasscock ME (1973) Tympanic membrane grafting: overlay vs. undersurface technique. *Laryngoscope* 88:754–770
3. Browning GG, Merchant SN, Kelly GK, Swan IRC, Canter R, Mckerrow WS (2008) Chronic otitis media. In: Gleeson M, Browning GG, Burton MJ, Clarke R, Hibbert J, Jones NS, Lund VJ, Luxon LM, Watkinson JC (eds) Scott-Brown's otorhinolaryngology, 7th edn. Hodder Arnold, London, pp 3421–3422
4. Wullstein H (1956) Theory and practice of tympanoplasty. *Laryngoscope* 66:1076–1093
5. Zollner F (1955) The principles of plastic surgery of the sound conducting apparatus. *J Laryngol Otol* 69:637–652
6. Shea JJ (1960) Vein graft closure of eardrum perforations. *J Laryngol Otol* 74:358–362
7. Tabb HW (1960) Closure of perforations of the tympanic membrane by vein grafts. *Laryngoscope* 70:271–286
8. Puhakka H, Virolainen E, Rahko T (1979) Long-term results of myringoplasty with temporalis fascia. *J Laryngol Otol* 93:1081–1086
9. Sheehy JL, Anderson RG (1980) Myringoplasty: a review of 472 cases. *Ann Otol Rhinol Laryngol* 89:331–334
10. Glasscock ME III, Jackson G, Nissen AJ, Schwaber MK (1982) Post auricular undersurface tympanic membrane grafting: a follow up report. *Laryngoscope* 92:718–727
11. Caylan R, Ttiz A, Falcioni M, Donato GD, Russo A, Taibah A, Taibah A, Sanna M (1998) Myringoplasty in children: factors influencing surgical outcome. *Otolaryngol Head Neck Surg* 118:709–713
12. Wright WK (1963) Tissues for tympanic grafting. *Arch Otolaryngol* 78:291–296
13. Mitchell JF (1967) Myringoplasty by homogenous vein graft. *J Laryngol Otol* 81:339–346
14. Adkins WY, White B (1984) Type I tympanoplasty: influencing factors. *Laryngoscope* 94:916–918
15. Wasson JD, Papadimitriou LE, Pau H (2009) Myringoplasty: impact of perforation size on closure and audiological improvement. *J Laryngol Otol* 123:973–977
16. Jackler RK, Schindler Ra (1984) Role of the mastoid in tympanic membrane reconstruction. *Laryngoscope* 94:494–500
17. Packer P, MacKendrick A, Solar M (1982) What's best in myringoplasty: underlay or overlay, dura or fascia. *J Laryngol Otol* 96:25–41
18. Nickel AL (1963) The use of homologous vein grafts in Otolaryngology. *Laryngoscope* 68:919–925
19. Strahan RW, Ward PH, Acquarelli M, Jafe KB (1971) Tympanic membrane grafting. Analysis of materials and techniques. *Ann Otol Rhinol Laryngol* 80:854–860
20. Glasscock ME (1973) Tympanic membrane grafting: overlay vs. undersurface technique. *Laryngoscope* 88:754–770
21. Hordijk GJ, Rietema SJ (1982) Tympanic membrane grafting with fascia, pericardium and vein. *J Laryngol Otol* 96:43–47
22. Palva T, Virtanen H (1982) Pit falls in myringoplasty. *Acta Otolaryngol* 93:441–446
23. Vartiainen E (1993) Findings in revision myringoplasty. *Ear Nose Throat J* 72:201–203
24. MacKinnon DM (1970) Relationship of pre-operative Eustachian tube functions to myringoplasty. *Acta Otolaryngol* 69:100–106
25. Balyan FR, Celikkanat S, Asian A, Taibah A, Russo A, Sanna M (1997) Mastoidectomy in non cholesteatomatous chronic suppurative otitis media: is it necessary? *Otolaryngol Head and Neck Surg* 117:592–595
26. Booth JB (1973) Myringoplasty factors affecting results. final report. *J Laryngol Otol* 87:1039–1084
27. Tos M, Lau T, Plate S (1984) Sensorineural hearing loss following chronic ear surgery. *Ann Otol Rhinol Laryngol* 93:403–409
28. Siraj Z, Mohammad A (1992) Transcanal tympanoplasty: dura versus temporalis fascia. *Ear Noise Throat J* 71:590–592
29. Sade J, Berco E, Brown M, Weinberg J, Avraham S (1981) Myringoplasty short and long-term results in a training program. *J Laryngol Otol* 95:653–665